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KEY DRIVERS OF MARINES' WILLINGNESS TO ADOPT ENERGY-EFFICIENT TECHNOLOGIES

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Why individuals adopt or resist technologies is a central question in technology management and energy conservation research. Much academic attention focuses on functional and economic advantages, but perceptions, habits, and norms play a more substantial role and are a particularly strong driver of resistance. Recognizing this, the Marine Corps Expeditionary Energy Office has called for research to better understand how messaging and behavioral factors will influence the shaping of a combat-effective energy posture within the Marine Corps.

This research examines how particular individual attributes may affect Marines' assessments of energy-efficient technologies. Drawing on a framework developed from the academic literature, this research focuses on the impact of a person's prior conditions, knowledge, and perception of technologies on the decision to adopt, postpone, or resist new technologies.

The research produced a summary of extant findings and implications for the United States Marine Corps concerning the typology of United States Marines' perceptions and willingness to adopt energy-efficient technologies. The research findings may offer the Marine Corps a clearer understanding of acceptance and resistance drivers, and the means to facilitate greater acceptance of energy-efficient technologies.

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KEY DRIVERS OF MARINES' WILLINGNESS TO ADOPT ENERGY-EFFICIENT TECHNOLOGIES

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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LIST OF ACRONYMS AND ABBREVIATIONS

CMC	commandant of the United States Marine Corps
CWO2	chief warrant officer 2
DoI	diffusion of innovations
DON	Department of the Navy
E2O	Expeditionary Energy Office
FMF	fleet marine force
GCSS	ground combat service support
IED	improvised explosive device
IRB	Internal Review Board
KIA	killed in action
MARFORSYSCOM	Marine Corps Forces Systems Command
MRAP	mine resistant ambush protective
NPS	Naval Postgraduate School
TAM	technology acceptance model
TRA	theory of reasoned action
USMC	United States Marine Corps
WIA	wounded in action

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I. INTRODUCTION

On August 13, 2009, the commandant of the United States Marine Corps (CMC) declared energy a top priority, and within six weeks' time, the Marine Corps Expeditionary Energy Office (E2O) was created. Its mission is to "analyze, develop, and direct the Marine Corps' energy strategy in order to optimize expeditionary capabilities across all War fighting functions" (Amos, 2010, p.5). The 35th Commandant of the Marine Corps USMC Expeditionary Energy Strategy directed the E2O to "develop a plan to decrease the Marine Corps' dependence on fossil fuel in a deployed environment" (Amos 2010, p.5). The directive encompasses both tactical and strategic objectives.

Tactically, energy efficiency is a relevant issue because forward-deployed fossil fuel dependency necessitates extensive convoy resupplies and, previously, every 50 fuel convoys have resulted in one United States Marine being wounded in action (WIA) or killed in action (KIA) (Amos 2010, p.7). Strategically, E2O's mission underscores the Marine Corps' current efforts to rebalance the force and ensure that America has the premier forward deployed, amphibious, self-sufficient expeditionary force, instilled with a warrior ethos. A premier and self-sufficient force requires the efficient use of vital resources with increased combat effectiveness. The adaptation and employment of energy-efficient technologies within an expeditionary environment will facilitate a lighter and faster force whose self-reliance will enable greater combat effectiveness.

A. PURPOSE AND RESEARCH QUESTIONS

The purpose of this study is to support the acceptance and adoption of efficient energy technologies by the United States Marine Corps through exploring what influences Marines' attitudes and willingness to adopt energy-efficient technologies. Specifically, this study draws from academic literature on technology adoption and diffusion and an analysis of interview and survey data to identify and explicate Marines' perceptions and practices related to efficient energy technologies, and the relationships between these and Marines' willingness to adopt such technologies. I discuss the

implications of the findings and make recommendations for supporting the adoption of energy-efficient technologies in Chapter V.

Why individuals adopt or resist technologies is a central question in technology management and energy conservation research. Much academic attention focuses on functional and economic advantages, but perceptions, habits, and norms play a more substantial role and are a particularly strong driver of resistance. Recognizing this, the Marine Corps E2O has called for research to better understand how messaging and behavioral factors will influence the shaping of a combat-effective energy posture within the Marine Corps.

The main objective of this research is to determine what drives United States Marines' acceptance and resistance to efficient energy technologies. This research

a. identifies the degree to which United States Marines are supportive of or resistant to efficient energy technologies,

b. examines the roles played by cognitive factors (awareness and understanding) and affective factors (attitude and perception) on stated willingness to adopt or resist efficient energy technologies, and

c. assesses the most likely levers for influencing cognitive and affective factors to support the adoption of efficient energy technologies by United States Marines.

B. BACKGROUND AND RESEARCH SETTING

The E2O was created to transform the way that the Marine Corps employs energy and resources to increase combat effectiveness and reduce logistical support requirements. While United States Marines will use the tools that they are told to, effective and lasting change is more likely when simultaneous interest and enthusiasm for the effort is generated, facilitating genuine acceptance. A unit evaluating energy technologies in Afghanistan proved the value of initially fielded energy technologies within an expeditionary combat environment. The unit cited how fewer battery requirements enabled greater ammunition loads, which reduced the need for both battery and ammunition resupplies. Reducing logistical support requirements supported greater freedom of action, thereby increasing combat effectiveness. Furthermore, decision-makers, charged with increasing combat effectiveness within an expeditionary

environment, must incorporate energy technology adaptation within a warrior mind-set. Thus, the Marine Corps seeks to create a change in ethos and culture.

This study draws on academic literature on technology adoption and diffusion. Technology adoption and diffusion theories seek to explain the processes and drivers of technology acceptance and use. Although much of the attention on the adoption of technologies focuses on the tangible—functional and economic advantages—these attributes alone do not determine a technology's success or failure. Three models, briefly described as follows, support the notion that beliefs, culture, perceptions, and communication processes strongly influence technology adoption and rejection decisions.

Rogers' (1995) Diffusion of Innovations (DoI) model presents diffusion from a change in communication framework to explicate the components of the communication process and their influence on the rate of adoption. Four assumptions of the DoI model are relevant to this project: (1) Decision-making is a process with identifiable stages moving from a change in knowledge to a change in behavior, (2) the decision process is initiated by prior conditions (e.g., perceived needs, social norms), (3) adopter characteristics and an innovation's attributes influence how knowledge is formed into object-specific attitudes, and (4) feedback from the later stages of the decision process to the initial stages are both internal or psychological and external or communicative (Wilson & Dowlatabadi, 2007). In this study, I examine the characteristics and predispositions that affect prior conditions, knowledge, and perceptions along the decision process, identifying the attributes contributing to technology innovation, adoption, postponement, and resistance.

Davis' (1989) technology acceptance model (TAM) proposes that assessments of a technology's usefulness and ease of use determine acceptance of the technology. Perceived usefulness is defined as the prospective user's subjective probability that using a technology will increase his or her job performance within an organizational context. Perceived ease of use refers to the degree to which the prospective user expects the target technology to be free of effort (Davis, Bagozzi, & Warshaw, 1989). Prior research indicated that end users are willing to forgo ease of use if the technology increases usefulness (Davis, 1989).

The resistance hierarchy details the predisposition of different antecedents to one of three types of resistance: postponement, rejection, and opposition. Antecedents include physical risk, economical risk, functional risk, social risk, traditions and norms, usage patterns, and perceived image. Recent research has examined how the combinations of antecedents establish a particular resistance hierarchy (Kleijnen, Lee, & Wetzels, 2009). In this study, I assume that opposition to technology is likely to take only the least strong form of negative communication in addition to the inclusion of adoption for considering resistance and adoption together.

This study is based on a framework developed from an adaptation of the DoI model (Rogers, 2003; Wilson & Dowlatabadi, 2007) elaborated with the technology acceptance model (Davis, 1989) and the resistance hierarchy (Kleijnen, Lee, & Wetzels, 2009). Chapter II describes the framework in detail.

C. ORGANIZATION OF STUDY

This report describes the study of United States Marines' acceptance of and resistance to efficient energy technologies. Chapter II presents a literature review on the academic concepts used to compose the research framework. Chapter III explains the methods used for this study. Chapter IV details this study's analysis. Chapter V offers discussion on pertinent discoveries and implications and gives recommendations to address those discoveries. Chapter VI details final thoughts, limitations of the research, recommendations for further research, and the overall benefits of the study.

II. LITERATURE REVIEW

A. INTRODUCTION

This chapter identifies and describes three technology adoption and diffusion models utilized in my research to identify Marines' predispositions toward and triggers of energy technology adoption, postponement, and resistance decisions. The following sections will explain the purpose, value, and limitations of the diffusion of innovations, technology acceptance, and resistance hierarchy models. Next, the methodology of the study framework, derived from the models, is described. The methodology drove the construction of an anonymous survey and interview protocol supporting the research. The chapter concludes with a purpose review and an explanation of the contributions from each theory to the study framework.

B. ROGERS' DIFFUSION OF INNOVATIONS MODEL

1. Description

The Diffusion of Innovations (DoI) model identifies and explains factors that influence the decision process of whether to adopt or reject an innovation. Developed by Everett Rogers in 1962, the DoI model depicts how innovations diffuse through populations or social systems. Rogers studied diffusion from a change in communication framework, scrutinizing how communication processes among people influence the rate of innovation adoption. Rogers' DoI model identifies a five-stage innovation-decision process and determining how unique attributes involving individuals, opinion-makers, social norms, ideas, and behaviors influence decisions among each of the five stages, which ultimately impact the adoption or rejection of an innovation. Rogers' model is depicted in Figure 1 and explained in the following sections.

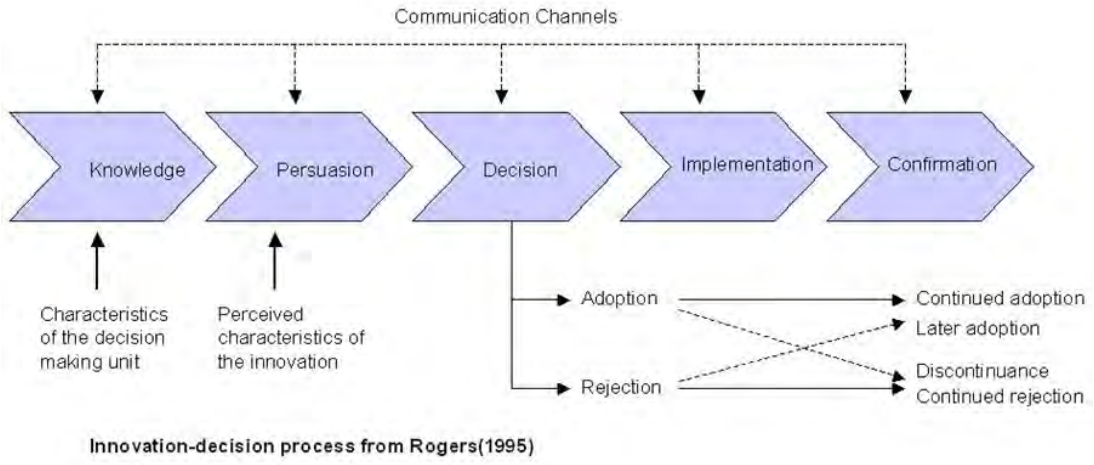

Figure 1. Diffusion of Innovations Model (From Rogers, 1995)

Rogers (1995) defined *diffusion* as a process by which an innovation is communicated through certain channels over time among the members of a social system. This definition implies that (1) potential adopters can be individuals, groups, or organizations at different levels of any social system, (2) the target of diffusion is innovation, (3) the process through which diffusion occurs is communication, (4) the means for communicating is provided by the path of communication channels, (5) the context of innovation is a social system, and (6) diffusion occurs through change over time (Rogers, 1995). An innovation is defined broadly as an idea, practice, or technology perceived as new (Wilson & Dowlatabadi, 2007).

2. Innovation-Decision Process

Rogers' (1995) explained the innovation decision-making process, composed of five identifiable stages, moves from a change in knowledge to a change in behavior. The five identifiable stages include knowledge, persuasion, decision, implementation, and confirmation. Knowledge occurs when a potential adopter of an innovation is exposed to the innovation's existence and gains insight on how it works. Persuasion arises when a potential adopter forms an attitude, either positive or negative, toward the innovation. Decision arises when a potential adopter engages in activities that determine whether to adopt or reject the innovation. Implementation happens when a potential adopter uses an

innovation. Confirmation occurs when a potential adopter seeks reinforcement of the decision to use the innovation or reverses their previous decision because of conflict.

3. Rate of Adoption

Rogers (1995) identified five factors that influence the rate of adoption: the nature of the social system, communication channels, perceived attributes of innovation, the type of innovation-decision, and the extent of the change agent's promotion efforts. The first factor that influences the rate of adoption is the nature of the social system. A social system is defined as a set of interrelated units (such as the non-commissioned officers of a platoon, the tenured professors of a college, or all the members of a political party) that are engaged in joint problem solving to accomplish a common goal. The social structure, patterned arrangements of the units in a system, affects the way that diffusion occurs within a social system. A social system encompasses system norms, roles of opinion leaders and change agents, types of innovation decisions, and the consequences of innovation. System norms are established behavior patterns for the members of a social system. Roles of opinion leaders and change agents affect the degree to which an individual is able to informally influence other individuals' attitudes or overt behavior in a desired way, with relative frequency. Types of innovation decisions, are described in greater detail later in this section, include optional innovation-decisions, collective innovation-decisions, and authority innovation-decisions. The consequence of innovation accounts for desirable versus undesirable (whether the effects of the innovation become functional or dysfunctional within the social system), direct versus indirect (if changes to the social system are immediate or the result of a second order effect to a different innovation), and anticipated versus unanticipated (changes were recognized and intended versus unintended.

Communication channels are the second factor that influences the rate of adoption. Communication is "the process by which participants create and share information with one another in order to reach a mutual understanding" (Rogers, 1995, p. 17). Messages are transferred from one individual to another through communication channels. Two types of communication channels are mass media and interpersonal

channels (Rogers, 1995). Mass media channels involve media such as the Internet, television, and radio, which facilitate the action of a few to reach an audience of many. Mass media facilitates reaching large audiences rapidly, creating knowledge, spreading information, and leading to changes in weakly held attitudes. Interpersonal channels involve face-to-face exchanges between two or more people, which enable individuals to seek clarification and create environments to form or change strongly held attitudes. Subsequently, interpersonal channels are more important at the persuasion stage of the innovation decision process, whereas mass media channels are more essential at the knowledge stage of the innovation decision process. Diffusion, within the context of the DoI model, is a specific type of communication that occurs to exchange a new idea with one or several others (Rogers, 1983).

Rogers' (1995) outlines the third factor of perceived attributes of innovation and describes how the perceived characteristics of a new idea, practice, or object impact the adoption process. Perceived attributes of innovation include relative advantage, compatibility, complexity, triability, and observability. Relative advantage describes the degree to which an innovation is perceived as better than the idea it supersedes. The underlying principle is that the greater the perceived relative advantage of an innovation, the more rapid its rate of adoption. Compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of potential adopters. Complexity denotes the degree to which an innovation is perceived as difficult to understand and use. Triability describes the degree to which an innovation may be experimented with. If an innovation is triable, it results in less uncertainty for adoption. Observability refers to the degree to which the results of an innovation are visible to others. The easier it is for potential adopters to observe the idea, object, or results, the more likely they are to adopt. The more favorable the combination of factors, the more positive the impact at the persuasion stage of the innovation-decision process. The higher degree of positive impact on the persuasion stage of the innovation-decision process, the more likely that a rapid diffusion of innovation leading to adoption will occur.

Rogers' (1983) explains how the fourth factor which impacts the rate of adoption is the type of innovation decision: optional, collective, and authority. The optional innovation decision gives the individual flexibility to adopt or reject an innovation regardless of any system consensus. However, in this circumstance, decisions may still be influenced by interpersonal networks or the norms of the individual's system. Previous research indicates that optional innovation decisions are more often than not influenced by community/system factors. Collective innovation decisions are choices made by a consensus among the members of a system to adopt or reject an innovation. Collective innovation decisions offer a balance between maximum efficiency and freedom, but the individual's choice of freedom is dictated by the nature of the collective innovation decision. Authority innovation decisions are choices made by a select few to adopt or reject an innovation for an entire system. Authority innovation decisions yield a high rate of adoption but also produce high resistance.

Rogers' (1995) identifies the fifth factor that influences the rate of adoption to be the extent of the change agent's promotion efforts. Change agents are people who introduce innovations into a society (workplace) with the expectation that the consequences that will be desirable, direct, and anticipated. Change agents achieve results through facilitating groups of people through a systematic process to develop, organize, and sell new ideas (Ellsworth, 2000). They are the invisible hands that turn vision into action. To be successful, change agents require the knowledge, skills, and tools necessary to implement change in the workplace or society. Rogers' (1995) DoI model provides guidelines for the change agents concerning what attributes can be incorporated into the innovation to facilitate acceptance by the intended adopter. Additionally, Rogers (1983) identified the sequence of change agent roles:

1. To develop a need for change.
2. To establish an information-exchange relationship.
3. To diagnose problems.
4. To create an intent in the client to change.
5. To translate an intent to action.
6. To stabilize adoption and prevent discontinuance.
7. To achieve a terminal relationship. (p. 315–317)

4. Value of Rogers' Diffusion of Innovations Model

Rogers' (1995) DoI model identified the significant elements in the change system and their characteristics. The DoI model is reasonably methodical since the outcome of change is confined within a predetermined innovation, which is tied to a predetermined goal. Ellsworth (2000) described the innovation attributes as the most critical benefits of Rogers' DoI model. He wrote:

> Practitioners are likely to find this perspective of the greatest use if they are engaged in the actual development of the innovation or if they are deciding whether (or how) to adapt the innovation to meet local requirements…Rogers' framework can be useful in determining how it [the innovation] is to be presented to its intended adopters. (p. 40)

Rogers' (1995) DoI model articulates how rates of adoption are influenced by key factors within an innovation-decision process occurring over communication channels. The DoI model primarily considers influences, ideas, behaviors, and communication within a social context but does not provide enough focus on individual adoption. However, the following technology acceptance model emphasizes essential individual factors.

C. TECHNOLOGY ACCEPTANCE MODEL

1. Description

The TAM identifies and explains the factors that influence information technology acceptance to predict acceptance and use of information technology and information systems by individuals. Developed by Fred Davis (1989), the TAM is considered one of the most influential research models concerning technology acceptance and has received considerable attention by researchers over the past decade (Chen, Li, & Li, 2011). The unique attribute of the TAM is how it provides the basis for tracing the impact of the external factors on internal beliefs, attitudes, and intentions. The TAM achieves this goal by identifying a small number of fundamental variables suggested by previous research dealing with cognitive (awareness and understanding) and affective (attitude and perception) factors of computer acceptance using theory of reasoned action

(TRA) as a theoretical backdrop for modeling the theoretical relationships among these variables (Davis, Bagozzi, & Warshaw, 1989). According to the TAM, technology acceptance is a function of a potential user's perceptions of a technology's usefulness and ease of use, as shown in Figure 2.

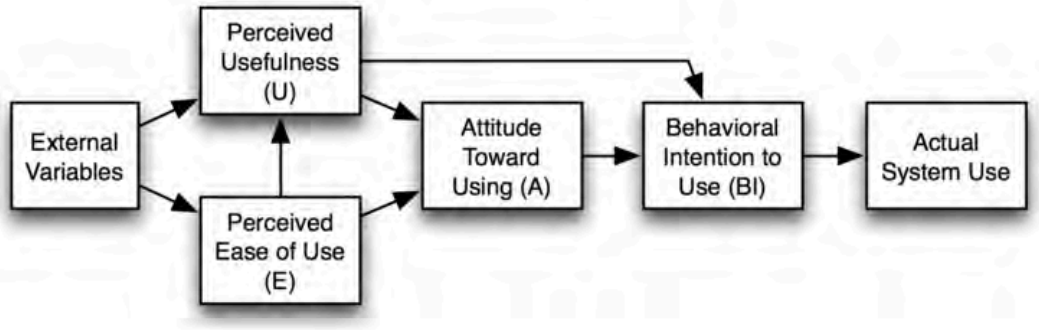

Figure 2. Technology Acceptance Model (From Davis, 1989)

2. Perceived Usefulness and Perceived Ease of Use

The perceived usefulness variable represents how people will use or not use an innovation to the extent that they believe it will aid them in doing their job better. Davis (1989) defined *perceived usefulness* as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320). The perceived ease of use variable considers that while someone may think the technology is useful, they believe that it is too difficult to use and that the benefits of employing the technology are outweighed by the effort required to use it. Davis (1989) described perceived ease of use as "the degree to which a person believes that using a particular system would be free from effort" (p. 320).

The TAM proposes that the assessments of two variables, perceived usefulness and perceived ease of use, determine a person's attitude toward using a technology, which in turn determines actual use. The model stipulates that actual system usage is determined by the behavioral intention to use. Behavioral intention to use (BI) is jointly determined by attitude toward using (A) and perceived usefulness (U), where

$$BI = A + U. \quad (1)$$

The model shows that people form intentions to perform behaviors that they believe will have beneficial impacts—the relationship between attitude toward using and behavioral intention to use. The TAM also demonstrates how the relationship between perceived usefulness and behavioral intention to use reveals itself within organizational systems when people develop intentions toward behaviors believed to increase their job performance, above any positive or negative feelings that may result from the behavior. However, the model also depicts that perceived usefulness has a direct effect on behavioral intention to use over and above attitude toward using (Davis, Bagozzi, & Warshaw, 1989).

The TAM also depicts how attitude toward using (A) is jointly determined by perceived usefulness (U) and perceived ease of use (E), where

$$A = U + E. \quad (2)$$

The TAM illustrates that if improved perceived ease of use enabled a person to accomplish more work with the same effort, contributing to improved performance, then perceived ease of use will directly affect perceived usefulness. However, perceived usefulness (U) is also affected by external variables over and above perceived ease of use (E), where

$$U = E + \text{External Variables}. \quad (3)$$

Visualize two systems of equal ease to use, but say that one system provides a better product. If that system produced a better product, it would be considered more useful. Finally, the TAM depicts how perceived ease of use (E) is determined by external variables, where

$$E = \text{External Variables}. \quad (4)$$

The external variables depicted in the TAM incorporate internal beliefs, attitudes, and intentions of numerous individual differences, situational constraints, and interventions by management that impact behavior (Davis, Bagozzi, & Warshaw, 1989).

3. The Value of TAM

Statistical research presented by Davis, Bagozzi, and Warshaw (1989) concluded that (1) use can be predicted reasonably well from intentions, (2) perceived usefulness is a major determinant of intention to use, and (3) perceived ease of use is a significant secondary determinant of intention to use. Interestingly, ease of use appeared to be processed from a self-efficacy perspective, where it was observed that as people learned to use a new technology, the perceived ease of use concern became less salient. The regressed data produced by the study convincingly supported that although ease of use is definitely important, users will accept a much lower threshold concerning perceived ease of use in order to benefit from a higher perceived usefulness. Overall, the study found that the ability to use well-informed measures of determinants in calculating innovation use reduces the risk associated with innovations being delivered for implementation and not being used (Davis, Bagozzi & Warshaw, 1989).

Additional research by Davis (1989) further substantiated the preceding findings. Davis (1989) found the usefulness–usage relationship to be considerably stronger than the ease of use–usage relationship. These findings are relevant because they point out the prominence of usefulness over ease of use as a strong correlate of user acceptance. Again, users will cope with difficulty concerning use for an increase in perceived usefulness, but no amount of ease of use will compensate for a lack of perceived use. Davis (1989) concluded that "users are driven to adopt an application primarily because of the functions it performs for them, and secondarily for how easy or hard it to get the system to perform those functions…Although difficulty of use can discourage adoption of an otherwise useful system, no amount of ease of use can compensate for a system that does not perform a useful function" (p. 333).

The TAM clearly articulates how individual factors influence information technology acceptance but fails to incorporate adoption influences within a social context, as concentrated on within the DoI model. However, neither the TAM nor the DoI model adequately considers resistance, which is the primary purpose of the resistance hierarchy described in the next section.

D. RESISTANCE HEIRARCHY

1. Description

The resistance hierarchy, depicted in Figure 3, details the predisposition of different antecedents to one of three types of resistance: postponement, rejection, and opposition (Kleijnen, Lee, & Wetzels, 2009). Antecedents include physical risk, economical risk, functional risk, social risk, traditions and norms, perceived image, and usage patterns. Recent research has examined how the combinations of antecedents establish a particular resistance hierarchy (Kleijnen, Lee, & Wetzels, 2009).

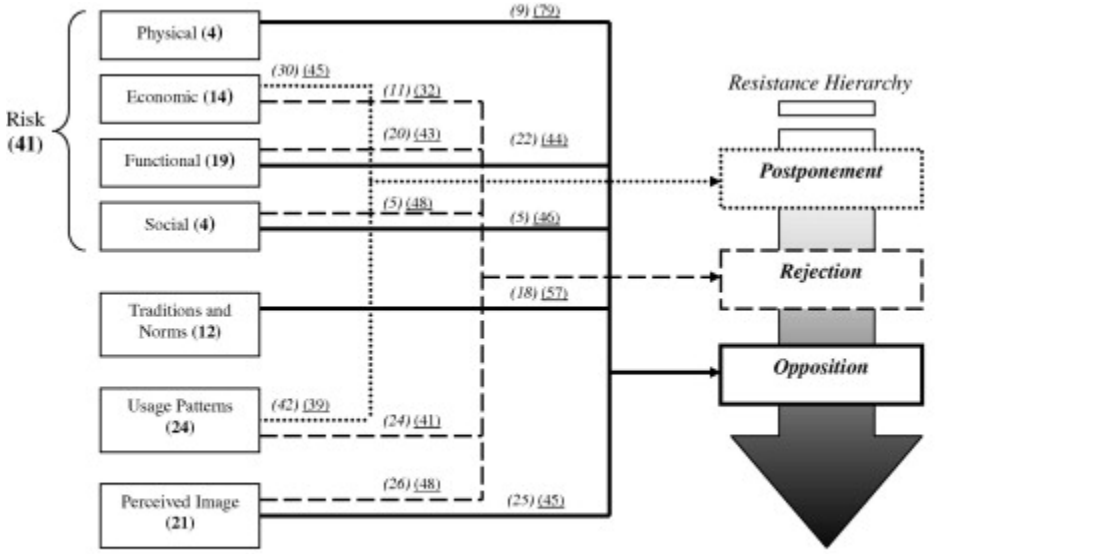

Figure 3. Resistance Hierarchy (From Kleijnen, Lee, & Wetzels, 2009)

2. Resistance

Ram and Sheth (1989) defined innovation resistance as "the resistance offered by consumers to an innovation, either because it poses potential changes from a satisfactory status quo or because it conflicts with their belief structure" (p. 6). Kleijnen, Lee, and Wetzels' (2009) research presented in the *Journal of Economic Psychology* explored the further delineation of resistance into three distinct types of behavior: postponement, rejection, and opposition.

Kleijnen, Lee, and Wetzels' (2009) study found postponement to be similar to delaying. They wrote:

> Although consumers find an innovation acceptable in principle, they may decide not to adopt it at that point time, for example until the circumstances are more suitable. In this case the decision is not final and this definition is similar to delay as a form of consumer resistance. (p. 345)

Adopters of innovation are more likely to be weary and suspicious of using a validated innovation until they feel that its application is standard.

Kleijnen, Lee, and Wetzels (2009) observed rejection as the result of an active evaluation by the consumer resulting in a strong reluctance to adopt. Their research supported that the strong reluctance to adopt stems more from an active evaluation of the innovation than a lack of awareness or ignorance. Other research by Hirschheim and Newman (1988) contended that rejection is further linked with a reluctance to change the status quo. Adopters are more likely to assess the value of the innovation themselves rather than the value of the implementer's market.

Kleijnen, Lee, and Wetzels (2009) likened opposition to sabotage. Other research by Davidson and Walley (1985) described innovation sabotage as strategies actively engaged in by consumers to prevent an innovation's adoption success. Opposition occurs when adopters become convinced that the innovation is unacceptable. The assumed premise of this study is that opposition is likely to take only the least strong form of negative communication, in addition to the inclusion of adoption for considering resistance and adoption together.

3. Resistance Antecedents

Kleijnen, Lee, & Wetzels (2009) explained how perceived risk influences the adoption of an innovation. Four types of risk that influence resistance within the resistance hierarchy are physical, economic, functional, and social. Physical risk addresses the perceived concerns by the adopter of the physical damage that could occur by using the innovation (e.g., Will using the innovation hurt the adopter or cause more harm than good?). Economic risk simply relates to the cost of the innovation (e.g., do the

benefits of the innovation outweigh the costs of it?). Functional risk encompasses doubt concerning the performance of the innovation (e.g., Will the innovation work, and what repercussions will the adopter have to endure if it does not?). Social risk represents how adopters weigh whether the innovation will be accepted or rejected by their social environment (e.g., Will the adoption of the innovation by the adopter result in the adopter being cut off or distanced from their social system?).

Several other antecedents influence the adoption of innovation. The three remaining types of drivers that influence resistance within the resistance hierarchy are traditions and norms, perceived image, and usage patterns. Traditions and norms address the traditional framework of customs and beliefs within an applicable social context. The more akin the innovation is within the threshold of the adopter's social context, the less resistance will occur (Herbig & Day, 1992). Perceived image encompasses an adopter's exclusive set of connotations based upon the innovation. The less desirable the innovation is perceived to be by the adopter, the higher the adopter's resistance will be (Ram & Sheth, 1989). Usage patterns relate to the customary behavior of adopters derived from consistently using a product over a substantial period of time. The more compatible an innovation is with an adopter's existing patterns, the less resistance will result (Ram & Sheth, 1989). Conversely, the more incompatible the innovation is with an adopter's existing patterns, the higher the acceptance barrier, resistance, will be (Herbig & Day, 1992).

4. The Value of Resistance Hierarchy

Statistical research presented by Kleijnen, Lee, and Wetzels (2009) in the *Journal of Economic Psychology* delineated the antecedent composition and working definitions for the types of resistance. Kleijnen, Lee, and Wetzels (2009) agreed that postponement was "an active decision to not adopt an innovation at that moment in time" (p. 352). Postponement, considered by Kleijnen, Lee, and Wetzels (2009) to be the weakest form of resistance, occurred when an innovation changed existing usage patterns and possessed economic risk. Kleijnen, Lee, and Wetzels (2009) referred to rejection as "the active decision to not at all take up an innovation" (p. 352). Rejection occurred when

innovation, changing existing usage patterns, and economic risk were combined with a poor image, social risk, and functional risk. Kleijnen, Lee, and Wetzels (2009) agreed upon opposition to refer to "actual active behavior directed in some way toward opposing the introduction of an innovation" (p. 353). Opposition, considered by Kleijnen, Lee, and Wetzels (2009) to be the strongest form of resistance, occurred when functional, social, and physical risk were combined with a conflict in existing traditions and a poor image.

The regressed data from Kleijnen, Lee, and Wetzels (2009) study in the *Journal of Economic Psychology* further evaluated the significant individual antecedents present within each type of resistance in the resistance hierarchy, as demonstrated in Figure 3. Postponement was most influenced by economic risk. Rejection was dominantly influenced by functional risk as well as social risk. Physical risk and conflict with existing traditions and norms were the dominant influencers of rejection. Overall, the study proved that several combinations of antecedents lead to risk but clearly demonstrated how perceived risk maintains the dominant role to innovation resistance.

E. STUDY FRAMEWORK

This study incorporated an adaption of the DoI model (Wilson & Dowlatabadi, 2007) elaborated with the TAM (Davis, 1989) and the resistance hierarchy (Kleijnen, Lee, & Wetzels, 2009) to identify Marines' predispositions toward and triggers of energy technology adoption, postponement, and resistance decisions.

Four assumptions of Wilson & Dowlatabadi (2007), concerning the DoI model are relevant to this study: (1) Decision-making is a process with identifiable stages moving from a change in knowledge to a change in behavior, (2) the decision process is initiated by prior conditions (e.g., perceived needs, social norms), (3) adopter characteristics and an innovation's attributes influence how knowledge is formed into object-specific attitudes, and (4) feedback from the later stages of the decision process to the initial stages are both internal or psychological and external or communicative This research further examined the characteristics and predispositions that affect prior conditions, knowledge, and perceptions along the decision process, drawn from the DoI model, in order to identify the attributes contributing to technology innovation adoption,

postponement, and resistance by incorporating individual factors of the TAM and the different risk antecedents described within the resistance hierarchy.

By incorporating the key ideas from each of the models previously discussed, the developed research framework (depicted in Figure 4) identities the factors likely to influence Marines' acceptance of efficient energy technologies. For the purposes of this research, the prior conditions along the decision process were generated upon a context consisting of a perceived need or problem considering traditions, norms, and usage patterns. The author based knowledge within the decision process upon the characteristics of the decision-maker, which included age, position/rank, education, and awareness/understanding of technology and communication patterns. Perception within the decision process incorporated perceived attributes of the technology, including relative advantage/disadvantage, compatibility, complexity, and image. Additionally, physical, functional, and social risk attributes were included with perception.

The framework drove the construction of an anonymous survey and interview protocol specifically designed to

- assess awareness of the objective, awareness of initiatives, sources of information, and satisfaction based upon experience;
- contrast acceptance in different environments;
- assess judgment of value;
- obtain perceptions and prior awareness related to technology acceptance;
- assess willingness to adopt, postpone, or resist innovation;
- ascertain perceptions of the problem, of fit with Marine traditions and mission, and of functional and physical risk, relative advantage, complexity, and compatibility; and
- assess an innovation's perceived ease of use and perceptions of usefulness.

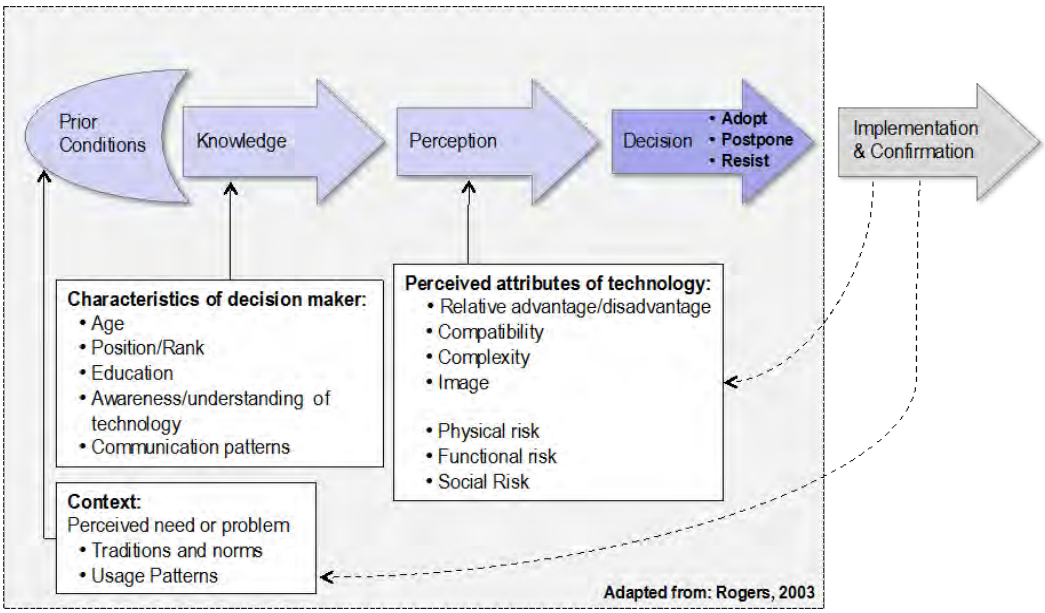

Figure 4. Research Framework (After Rogers, 2003)

F. CONCLUSION

It is important that Marines use and support efficient energy technology adoption because recent operations over the last 10 years have resulted in an exponential increased dependence upon fossil fuel, which must be changed. This dependence tethers operations to vulnerable supply lines, subsequently degrading the expeditionary capabilities of the Marine Corps, and puts Marines at risk. Our current and future operating environments necessitate an expeditionary mind-set focused on increased efficiency and reduced consumption, which will make our forces lighter and faster (Amos, 2010).

However, this adoption will require a change in ethos and culture. This change requires equating the efficient use of vital resources with increased combat effectiveness. Through innovation and a willingness to adopt efficient energy technologies, the Marine Corps will ensure that it continues to live, train, and fight as America's premier forward deployed, amphibious, self-sufficient expeditionary force.

In this section, three theories explaining the adoption of technologies were reviewed and then integrated to develop a framework for this study. Why individuals adopt or resist technologies is a central question in technology management and energy

conservation research. Much academic and literary attention focuses on functional and economic advantages, but perceptions, habits, and norms play a more substantial role and are a particularly strong driver of resistance.

The resistance hierarchy provided the ability to identify antecedents to resistance. The TAM identified how individual factors that influence information technology acceptance can predict individuals' acceptance and use of information technology through emphasizing valuable determinates concerning perceived usefulness and ease of use. The DoI model afforded an explanation of factors that influence the adoption or rejection decision process within a social context considering influences, ideas, behaviors, and communication. Together, the theories provided a framework that guided this study.

III. METHODS

A. INTRODUCTION

This study examines to what degree United States Marines are supportive of or resistant to efficient energy technologies. This study is based on multiple Fleet Marine Force (FMF) units who were asked to participate in research, sponsored by the E2O, to determine what drives Marines' acceptance of and resistance to efficient energy technologies. Anonymous online survey links were distributed to all FMF unit members in conjunction with on-site, face-to-face interviews with key decision-makers, both of which comprised the research. 123 anonymous usable surveys were returned, for a response rate of approximately 41%, and 11 on-site interviews were conducted with key decision-makers.

The online anonymous survey and on-site interviews were designed to explore how cognitive factors (awareness and understanding) and affective factors (attitude and perception) affect United States Marines' decisions concerning their willingness to adopt or resist innovation. The survey was reviewed and approved by the Department of the Navy (DON) Internal Review Board (IRB), the Marine Corps IRB, the Marine Corps Survey Officer, and selected Naval Postgraduate School (NPS) professors as well as vetted for effectiveness by several multiple-service NPS students.

With this survey, the suthor sought (1) to examine the characteristics and predispositions that affect prior conditions, knowledge, and perceptions of innovation along the technology adoption decision process and (2) to identify how attributes of (a) context (perceived needs, social norms) affect prior conditions, (b) characteristics (age, position/rank, education, awareness/understanding of technology, communication patterns) influence how knowledge is formed, and (c) perceived attributes of technology (relative advantage/disadvantage, compatibility, complexity, risk) affect perception. After consenting to participate, Marines were introduced to the survey objective, as follows:

> The Marine Corps Expeditionary Energy Office (E2O) is tasked by the Commandant of the Marine Corps to "analyze, develop, and direct the Marine Corps' energy strategy." Your responses to this survey will increase our understanding of Marines' awareness and experience of energy-efficient technologies informing our Fleet engagement efforts and helping ensure our investments deliver maximum value for the Marine Corps.

The survey consisted of five separate sections, following the consent section, including awareness, open-opinion, environment, perception, and characteristics. Awareness questions were designed to assess the Marine's awareness of (1) the E2O objective and (2) satisfaction with energy-efficient technologies based on experience, initiatives, and sources of information. Open-opinion questions were intended to help understand individual opinions concerning risk associated with the employment of energy-efficient technologies. Environment questions were devised to contrast acceptance of E2O technologies in different environments and assess judgments of value. Perception questions were designed to:

- assess perceptions of the problem;
- assess a willingness to adopt, postpone, or resist energy-efficient technologies;
- assess perceptions of fit with Marine Corps traditions and mission;
- assess perceptions of functional and physical risk;
- assess perceptions of relative advantage, complexity, and compatibility;
- assess perceived ease of use; and
- assess perceptions of usefulness.

Characteristic questions requested individual demographic information, including age, rank, highest education attained, number of completed deployments within the previous four years, years of service, and Military Occupational Specialty (MOS). The sampling frame for this study consisted of officers in the ranks of chief warrant officer 2 (CWO2) through lieutenant colonel (O-5) and enlisted ranks between private (E-1) and sergeant major/master gunnery sergeant (E-9). The resulting sample totaled 134 Marines currently stationed within selected FMF units.

B. DATA

Data were collected through an online survey and face-to-face on-site interviews. An email was sent to several Marine Corps fleet units of more than 300 Marines asking them to participate in an anonymous survey, sponsored by the E2O, to determine what drives Marines' acceptance of and resistance to efficient energy technologies. More than 123 participants chose to complete the survey. 11 Marine key decision-makers participated in the on-site, face-to-face interview portion of the research.

C. DATA ANALYSIS

The suthor adopted inductive theory-building approaches involving a series of meaning condensation and categorizing driven by a hermeneutic process. I conducted an iterative reading through all of the responses to gain an understanding of the data. I then categorized and coded the responses and subsequently placed representative quotes and coding in tables to allow for comparison. I then used this analysis as a basis for discussion and recommendations.

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IV. ANALYSIS

A. INTRODUCTION

Data for this research was collected through on-site interviews and an anonymous online survey. The survey was designed to get a sense of what influences Marines' attitudes and willingness to adopt energy-efficient technologies. Data from the survey documents each Marine respondent's personal characteristics as well as his or her awareness of, perceptions of, and environments concerning energy-efficient technology adoption. (Appendix A shows a copy of the survey.)

This chapter describes the data collection, analysis, and results of the study. First, data are quantified by providing the number of survey and interview respondents, describe the types of questions asked, and indicate the level of responses provided during the on-site interviews. Second, data analysis breaks the responses into the following categories: awareness, environment, perception, characteristics, and implementation. Within these categories, the author incorporated comments from the on-site interviews, which provide further insight into considerations of the decision maker when deciding to adopt or resist energy-efficient technologies. Third, a summary details the findings. Of note, all of the quotations contained in this chapter received spelling and punctuation corrections, if required; however, no grammatical corrections were made to any quotations.

B. PARTICIPANTS

Two Marine Corps fleet units were asked to participate in an anonymous survey designed to determine what drives Marines' acceptance of and resistance to energy-efficient technologies. The units included approximately 300 Marines in total. One hundred and twenty-three usable surveys were returned, for a response rate of approximately 41%. The survey consisted of 40 forced-choice and seven open-opinion questions. Table 1 summarizes the survey sample participants by rank.

Table 1. Survey Sample

Please list your rank	Response count	Response percentage
E1-E3	78	76.47%
E4-E6	16	15.69%
E7-E9	1	0.98%
O1-O3	5	4.90%
O4-O6	1	0.98%
O7-O10	1	0.98%

Note. The total number of respondents was 123; 21 participants did not answer every question on the survey.

Additionally, there were more than 82 pages of transcribed responses from on-site interviews conducted with 11 key decision-makers among infantry and communication units. On-site interviews allowed participants to provide additional thoughts and details on decision maker considerations when deciding to adopt or resist energy-efficient technologies. Table 2 summarizes the on-site interview participants by rank.

Table 2. Interview Participants

Rank	Participant count
CWO2	1
O2	1
O3	6
O4	1
O5	2

C. AWARENESS

The survey included awareness questions that were designed to assess familiarity with the E2O objective and satisfaction based on experience with energy-efficient technologies, advertised initiatives, and sources of information concerning energy-efficient technologies. In order to assess respondents' awareness, an array of questions was presented. Initial analysis involved assessing familiarity with the commandant of the Marine Corps (CMC) intent and the E2O objective.

1. Awareness of E2O and CMC Goal

More than half of the survey participants (51.89%) were aware of the commandant's goal to reduce dependence on traditional fuel and increase capability for

deployed Marine forces through new technologies and procedures, but only 9.52% of participants had heard of the E2O prior to taking the survey. The data are summarized in Table 3.

Table 3. Awareness of the E2O and CMC Goal

Are you aware of the Commandant's goal of reducing dependence on traditional fuel and increasing capability for deployed Marine forces through new technologies and procedures?	Response percentage	Have you heard of the Marine Corps Expeditionary Energy Office, also called E2O?	Response percentage
Yes	51.89%	Yes	9.52%
No	48.11%	No	90.48%

The majority of participants who responded being aware of the Commandant's intent, (40%) had learned of the CMC's goal from either informal word-of-mouth or informal electronic communication, while less than 22% had learned of it through official communication channels. Twenty percent of participants who reported being aware of the E2O had learned of the E2O through informal means, while less 10% had heard of the E2O through official communication channels. The data are summarized in Table 4.

Table 4. Source of E2O and CMC Goal Awareness

How did you become aware of the CMC's goal?	Response percentage	How did you become aware of the Marine Corps Expeditionary Energy Office (E2O)?	Response percentage
Informal word of mouth from another Marine	32.38%		14.29%
Informal Marine electronic communication	7.62%		4.76%
Official communication from Marines	12.38%		6.67%
DoD website	7.62%		1.90%
DoD printed newsletter	1.90%		0.95%
Prior to this survey I was not aware	19.05%		34.29%
I don't know	30.48%		41.90%
Other	5.71%		0.95%

During the on-site interviews, several communication company commanders' comments suggested a simultaneous multi-tiered approach to increase awareness and embed the commandant's goal within the ethos of the Marines. That approach included personal mentorship, introducing the technologies within the school houses, commanding officer engagement, and CMC messaging. The following statements summarize the commanders' ideas for increasing awareness:

- You have got to connect the big dots. You have got to connect the dots for the Marines. You have got to show them the bigger picture and it goes—I mean definitely in the commandant's directive will give them the interest or the perspective of it, of the senior leadership. But also, explaining to them why it is an important part of our ethos, getting the details, connecting the dots for them. It can't just be hey we have got a system that is going to make this better. We have got to really unfortunately hold their hand and really help them out.
- You know a smaller unit—I think at the company level it has to be addressed from the CO at a company level, battalion. The Marines need to hear it multiple times. Articles need to be—I mean Marines need to see it visually and then they will start, "Oh, I have heard the CO talk about this and now I am reading about it. The commandant just gave a [inaudible] just last week. Or something like that. They just need to start feeling like it is part of ethos before it even is, if that makes sense.
- Yes, and it certainly necessitates a shift in the mindset from the leadership level before you are going to be able to effect much in terms of your Marines just at the company level. We are talking about proving to the Marines that this is a good way to do business, be it discussing it as a company commander at the company level and making sure that they understand. Maybe how tied it is to the strategic level, like to bring that into it, but I think that you need to prove to them that it is effective as well before you are going to get a lot of buy in.
- "I would start at the schoolhouse, like from there."

An infantry company commander explained that tying the commandant's goal of increasing capability to force protection would facilitate embedding the adaptation of energy efficiency to the current ethos. However, he also felt that selling the technology needed to occur at the battalion command and levels above. He explained these thoughts in the following statements:

- Tie it to our ethos. Marines understand the inherent danger of going down an IED ridden road for constant resupply of something that is a consumable. If they can reduce that, they reduce the amount of patrols

and it is tied directly to force protection. That message is—we are very receptive to that I think inside of our community, the ability to be self-reliant I think is always going to be prime in our mindset. So continuing to push that message or that theme of this reduces outside requirements, makes us more survivable, makes us more expeditionary, it continues to be a good selling point.

- I think it is easy to convince a lance corporal that this is more efficient for you. They will do what they are told in that regard and he will understand the benefits of it when he is reaping the reward. He doesn't have to leave and go on a patrol to go get more batteries. He is able to just put a charger out. To me, that is an easy sell but you are going to need to convince people that it is probably going to be at a higher level I would say.

An infantry company executive officer offered a practical application approach based upon his own personal experience with energy-efficient technology acceptance while attending the Infantry Officer Course:

- By having the Marines use it. By having them buy into it like this (expletive deleted) works. Like this—you know—this stuff we can do like sustainment, sitting on a FOB, like we don't have to worry about air dropping anything or logistics coming through and getting blown up by an IED. Like hey, we can do this ourselves, we don't have to rely on anybody else really.

Although more than half of participants answered that they are aware of the CMC's goal, slightly less than half of the participants knew of E2O. The data suggests that awareness of the CMC's goal and of the E2O's roles in achieving that goal are not widely dispersed.

2. E2O Technologies Knowledge, Awareness, Experience, and Satisfaction

More than 70% of survey participants responded that they did not know about any recently developed energy-efficient technologies fielded by the E2O. Approximately 80% of participants responded that they have never used or personally tried any recently developed energy-efficient technologies fielded by E2O. The data are summarized in Table 5.

Table 5. E2O Technology Knowledge

The Marine Corps Expeditionary Office (E2O) has developed new energy efficient technologies. Which Marine Corps E2O tools/technologies do you know about?	Response percentage	Which of the following Marine Corps E2O technologies have you personally used or tried:	Response percentage
SPACES	3.81%		1.90%
GREENS	5.71%		3.81%
LED Lighting	20.00%		10.48%
Solar Light Poles	16.19%		5.71%
Zero Base	0.00%		3.81%
Radiant Tent Liners	4.76%		2.86%
None	71.43%		80.00%
Other	0.95%		0.95%

More than 69% of survey participants responded that they were not aware of any recently developed energy-efficient technologies fielded by E2O. For those respondents who were aware of the E2O's recent technologies, briefings were discovered to be the single highest source (9.52%) of E2O energy-efficient technology awareness. The data are summarized in Table 6.

Table 6. E2O Technology Awareness

How did you become aware of the Marine Corps E2O tools/technologies?	Response percentage
Through personal use	8.57%
Through demonstration	3.81%
Through a briefing	9.52%
Through concept introduction (media, MARADMIN, etc.)	3.81%
Through New Equipment Training (via MARFORSYSCOM)	2.86%
Through word of mouth (what you have heard from colleagues)	8.57%
Prior to this survey, I was not aware of these technologies	69.52%
Other	5.71%

Combined, 15% of survey participants responded to having used Marine Corps E2O tools and/or technologies within various circumstances, including combat and training outside of the continental United States. More than 80% of survey participants reported never using E2O tools or technologies in any circumstance. The data are summarized in Table 7.

Table 7. E2O Technology Experience

In what circumstances have you used Marine Corps E2O tools/technologies?	Response percentage
Never	84.62%
Humanitarian mission	1.92%
CONUS training	6.73%
OCONUS training	3.85%
Combat operations	3.85%
Other	0.96%

Less than 10% of respondents (6.73%) felt either not at all satisfied, or somewhat not satisfied with E2O tools or technologies that they previously used or tried. More than 16% of respondents felt either somewhat satisfied or satisfied with previously used or tried E2O tools and technologies. However, more than 70% of survey participants reported having no experience with E2O technologies. The data are summarized in Table 8.

Table 8. E2O Technology Satisfaction

Please rate your satisfaction with Marine Corps E2O tools/technologies that you have used or tried.	Response percentage
1 Not at all satisfied	3.85%
2 Somewhat not satisfied	2.88%
3 Neither satisfied or not satisfied	4.81%
4 Somewhat satisfied	11.54%
5 Satisfied	4.81%
6 Extremely satisfied	0.00%
I have no experience with E2O technologies	72.12%

Seventy-five percent of survey participants reported not informally discussing, reading, or hearing about the Marine Corps and how it relates to energy efficiency.

However, more than 16% of survey participants indicated that informal discussion with Marine peers is the single largest source where they received information concerning the Marine Corps and energy efficiency. Survey respondents also reported that Internet news is the single largest media source of information concerning the Marine Corps and energy efficiency. These data are summarized in Table 9.

Table 9. Sources of Information Regarding the Marine Corps and Energy Efficiency

From which media sources have you read or heard about the Marine Corps and energy efficiency?	Response percentage	With who have you informally discussed the Marine Corps and energy efficiency?	Response percentage
Radio (please list program if you recall)	3.85%		
TV (please list program if you recall)	3.85%	Marine peers	16.35%
Internet news (please list site if you recall)	7.69%	Marine superiors	5.77%
Internet blog site (please list site if you recall)	3.85%	Marine subordinates	1.92%
Social media site such as Facebook (please list site if you recall)	1.92%	Family	3.85%
Forwarded email or link (please describe if you can)	3.85%	Civilian friends	3.85%
I have not read or heard about the Marine Corps and energy efficiency	75.00%	I have not discussed with others	75.00%
Other	9.62%	Other	1.92%

Four open-opinion short-answer questions presented within the survey were designed to ascertain an understanding of awareness regarding what Marines consider to be energy-efficient technologies, their purpose, and utility. The first two open-opinion questions focused on what Marines believe energy-efficient technologies are and what purpose those technologies serve. The final two open-opinion questions focused on the needs that Marines believe energy-efficient technologies could address in both the short and long term.

The first question asked, “Some tools and technologies are ‘energy-efficient.’ Please list one or several technologies or products that you consider to be examples of ‘energy efficient technologies.’” Of the 123 survey participants, 100 chose to respond to this question. Sixty-five percent of the answers to the question contained standard common technologies including solar panels, wind farms, LED lights, and hybrid cars.

Ninety-five participants answered the second question, which asked, "What tools or technologies do the examples you listed above replace?" The relevant answers concentrated upon new technologies reducing the needs for batteries, fossil fuel, generators, and money in terms of cost.

The third open-opinion question asked, "In your opinion, what Marine Corps problems or needs can energy-efficient tools/technologies address now or in the immediate future (if none please explain)?" For the fourth question, the same statement was asked again but for the longer term. Of the 123 survey participants, 93 chose to comment on both the third and fourth open-opinion questions. Responses concerning issues that might be addressed by energy-efficient technologies in the immediate future included funding constraints, fossil fuel consumption, battery requirements, and operation efficiency. Long-term issues primarily addressed cost. Following are responses to the third open-opinion question:

- "I believe that the Marine Corps does not have an energy efficiency problem, rather a lack of funding, but I believe that the uses of energy-efficient technologies would aid the corps in acquiring more funding from the federal government."
- "Money issues.", "low budget.", and "funding."
- "Less expense on fuel and other expensive products used for energy."
- "The amount of fuel consumption.", "fuel consumption.", "fossil fuels." and "Less need for batteries."
- Sustainability at all levels. From the individual to the small unit, all the way up to the Corps as a whole. If you tie up less resource in transporting fossil fuels you could re-task those resources to anything else you needed. Not to mention less resources would be needed to transport a thing, if convoy components became more energy-efficient.
- "Expeditionary forces can reduce their logistical requirement if energy-efficient technologies are implemented"
- "It could possibly help in many ways, not using fuel, and using energy in cases of combat could help, in the sense of no more resupply convoys for fuel, therefore could possibly save lives."

Following are responses to the fourth open-opinion question:

- "Sustainability/survivability. Operation costs. Op Tempo possibly, if these 'energy-efficient' means lead to less time obtaining and utilizing power

sources/fuel. Carbon footprint. Pollution. Reduction in overall cost, in the long run."

- "Maintenance costs, training costs, lack of internal ability to maintain gear."
- "It could save the Marine Corps from spending so much money on fuel."

Other than being aware of the commandant's goal to reduce dependence on traditional fuel and increase the capability for deployed Marine forces through new technologies and procedures, there appears to be a large lack of awareness within battalion levels concerning actual technologies and methods for the way ahead in achieving the commandant's goal. Despite the general lack of awareness concerning the E2O and associated energy-efficient technologies (as observed within the forced-choice responses of the survey portion), open-opinion survey answers revealed that Marines understand the concept of how energy-efficient technologies could provide benefits to the Marine Corps. On-site interviews with key decision-makers produced several suggestions by company grade officers on how to incorporate the CMC's goal within Marine ethos.

D. ENVIRONMENT

The survey's environment questions were intended to contrast participants' acceptance of E2O tools and technologies in different environments and assess participants' judgments of the technologies' value. In order to contrast participants' likely use and sense of usefulness concerning E2O technologies and tools, the survey included several continuum-scale-based questions. Analysis of likely use involved contrasting employment of E2O tools and technologies among unevaluated (unit) training events, evaluated training events (combined armed exercises), and combat environments. Analysis of value consisted of determining the relative value attributed to E2O tools and technologies by Marines who participated in the survey. Of note, the largest percentage of participants, between 33.01% and 42.74%, answered "I don't know" to questions to ascertain perceived value. However, the majority of those who did respond indicated reluctance to employ E2O tools or technologies in any environment and felt that energy-efficient tools and technologies were likely to be not at all valuable to Marines. These data are summarized in Table 10.

Table 10. Environment

	1. Not at all	2	3	4	5	6. Extremely	7. I don't know
If given the choice, how likely are you to employ new energy efficient tools/technologies in an un-evaluated training environment?	15.38%	5.77%	11.54%	12.50%	10.58%	10.58%	36.54%
How enthusiastic are you about using new energy efficient tools/technologies in an evaluated training environment?	21.36%	5.83%	11.65%	11.65%	9.71%	6.80%	33.01%
If given a choice, how likely are you to use energy efficient tools/technologies in a combat environment?	22.33%	6.80%	5.83%	11.65%	4.85%	10.68%	42.72%
How valuable are energy efficient tools/technologies likely to be to Marines?	14.56%	6.80%	8.74%	14.56%	8.74%	8.74%	37.86%

On-site interviews provided an in-depth view of key decision-makers' decision processes concerning employment of E20 technologies within unevaluated and evaluated training environments. Several company commanders candidly suggested eliminating any options and forcing employment of energy-efficient technology through a one-for-one inventory swap as the only viable way to achieve energy-efficient technology acceptance. This opinion is conveyed in the following statement:

- • Force us to use it. I mean if you do a one for one swap it forces us to use it and as long as it has that guarantee back in it saying yes the MARFORSYSCOM says yes this is going to work just like a regular generator when it comes to liability and type of power it produces, I mean that is enough for me to take confidence in it and let it prove otherwise. But, force it to us. Force us to use it because if it comes down to them saying, 'Hey we are going to give you these systems. Use it when you go

> out to the field.' But, the Marine Corps ultimately says, 'Oh, you have generators to maintain and take out to the field as backup.' I am just going to take the generators because to a point it is overkill, it is too much work.

The following statements are company commanders' responses regarding what systems (standard or E2O) they would use given an option during a battalion training exercise:

- "I mean I will say if I have it on my dime, if I had my time to go out in the field and operate, I would take it out there because I would want to see it. But if I am going out with the battalion, I am going to rely on what I know."
- "Whatever I know works—Yes, unless it is a one for one swap and you have to use it, it is always going to be personality driven as far as what you are using."

The majority of survey participants remained undecided concerning which environment or what their level of enthusiasm would be for employing energy-efficient technologies. However, on-site interviews garnered a viable method for improving environmental employment decisions. Several company commanders suggested forcing employment of technology within training environments via one-for-one inventory swaps.

E. PERCEPTION

1. Perception of the Problem and Mission Consistency

Approximately 59% of participants responded that they neither agreed nor disagreed with whether dependence on traditional energy is a problem that puts Marines at risk. However, less than 14% of respondents either disagreed or strongly disagreed that increasing energy efficiency and reducing the use of traditional fuels are consistent with the mission of the Marine Corps. These data are summarized in Table 11.

Table 11. Perception of the Problem of Dependence on Traditional Energy Endangering Marines and Mission Consistency

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
Dependence on traditional energy could put Marines at risk.	11.65%	8.74%	59.22%	13.59%	6.80%
Increasing energy efficiency and reducing the use of traditional fuels are consistent with the Mission of the Marine Corps.	7.84%	5.88%	64.71%	11.76%	9.80%

Additionally, on-site interview conversations revealed a lack of motivation in focus concerning the problem of dependence on traditional energy putting Marines at risk and a conceptual disbelief that the E2O technologies will actually work, but they also offered viable solutions to address respective deficiencies. Respondents suggested that (1) broader communication of the problem would focus individual Marines on increasing energy efficiency and (2) published reports validating E2O technologies' effectiveness disseminated to the battalion level would establish confidence in the technologies. The following statements capture these perspectives:

- I think in this battalion specifically I think most Marines are not focused on it at all. There is no motive, there is no specific motive on—we are not infantry battalion where you lighten my pack by given me—despite the fact that we can use some of the technology in place of batteries, we don't routinely hump to where we are going. I mean we have elements that go out as detachments, but in general I don't think Marines go, in my opinion, they don't go day to day thinking of how can I be more efficient or how can I save money or whatever it may be. The systems you see a lot of what is across the street, it is just not a daily thought in their minds. They go to school specifically to learn how to maintain those systems and they just don't think about it and I can honestly say I don't ever hear Marines consciously say, 'How can we save money?' Or, 'How can we lighten our load or our footprint?' That is just not a discussion. Not saying it shouldn't be, it absolutely should be, but how do you get that ingrained in the minds of the Marines? It has to be some kind of motive. You know and from a [planner's] perspective, if you could tell me I could go out with something smaller than these big generators and air conditioners you see across the street, when you are talking about lift and the vehicles you need

to pull all these generators and ACs, then that is a big motivation from the leadership. It is not a motivation necessarily from the younger Marines.

- I mean it is just like—it is capitalism so people like the iPod because it works and it meets a need that they have. So if there is no need there and we are trying to produce something—I would make the argument that if there is an alternative to fuel that is cheaper, easier to produce, that would give us a better applicability at the military then everybody would jump on it. Same thing with solar power. If solar power was so much better than electricity in terms of efficiency and cost why haven't people jumped on it? Probably because it is not as efficient as people are saying it is. It doesn't produce as much power.
- So when I look at the solar farms I ask myself how much did that cost to do that solar farm? I see these new barracks that are being built with the overhang garages with solar power and I see these old barracks and I am like how much of that money could have been taken to pump into these barrack spaces? I don't know. The other question I have is if we are putting solar power to use, let's see how effective it is. Produce a report that states of these so many solar panels that we have installed at Camp Lejeune, they have produced this amount of electrical power which has therefore decreased the need for the coal plant on base to produce power, which has saved us this amount of money. You never see that. So my initial question is, are we really saving any money?

The largest percentage of survey participants have yet to form an opinion on whether dependence on traditional energy is a problem that puts Marines at risk or if reducing the use of traditional fuels through increasing energy efficiency is consistent with the mission of the Marine Corps. However, the on-site interview comments provided viable methods to increase motivation toward focusing on the problem and to communicate that the E2O technologies actually increase energy efficiency.

2. Willingness to Adopt, Postpone, or Resist Energy-Efficient Technology

While 49% of the participants were neither interested nor disinterested in using or trying E2O tools or technologies now or in the near future, more than 35% indicated an interest in using the technology (versus the less than 16% who indicated a complete disinterest in using the technology as soon as possible). More than 25% of respondents agreed or strongly agreed that they would only be interested in trying E2O tools or technologies after others they know have used them (as compared to the 20% who

disagreed or strongly disagreed). Less than 9% of participants agreed or strongly agreed that they were likely to criticize new energy-efficient tools and technologies or to discourage others from using them. The data are summarized in Table 12.

Table 12. Willingness to Adopt, Postpone, or Resist Energy-Efficient Technology

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I am interested in trying new energy efficient tools/technologies now or as soon as possible.	9.80%	5.88%	49.02%	23.53%	11.76%
I would only be interested in trying new energy efficient tools/technologies after others I know have tried them.	11.76%	8.82%	53.92%	19.61%	5.88%
I have or I am likely to criticize new energy efficient tools/technologies or to discourage others from using them.	15.69%	15.69%	59.80%	4.90%	3.92%

Although the largest percentage of survey responses to the forced-choice questions indicated not having an opinion, one open-opinion question designed to elicit what would motivate Marines to use the new technologies asked, “What would make you more enthusiastic about using energy-efficient tools/technologies?” 100 of the survey participants responded. Interestingly, the responses revolved around increasing Marines’ knowledge concerning the technologies’ availability, perceptions of usefulness, and ease of use. Several example responses are provided as follows:

- “learning about them.” and “more information on the tools.”
- “Classes and hands-on training on how to fix broken parts”
- “Ease of use and availability.” and “Actually getting those products.”
- “If I didn't have to go out of my way to use them (i.e., if they were as readily available as the stuff we have now).”
- “If it benefited training.” and “if it increased effectiveness”

- "You give me something that the average Marine can use right out of the box and can fix without extensive training and I'll be more apt to listen."
- "Lightweight, field expedient, robust. Efficient. Works with the gear I have/will have."

The majority of participants have yet to form an opinion on whether to adopt, postpone, or resist energy-efficient tools and technologies. However, open-opinion responses revealed what Marines desire and consider when deciding whether to adopt, postpone, or resist energy-efficient tools and technologies.

3. Perceptions of Functional and Physical Risk

Less than 12% of survey respondents agreed or strongly agreed that new energy-efficient tools or technologies will likely work as planned (versus the 25% who either disagreed or strongly disagreed on the topic). Similarly, slightly more than 12% of participants agreed or strongly agreed that using new energy-efficient tools or technologies would likely pose a risk to themselves or others (compared to approximately 18% who either disagreed or strongly disagreed). A significant majority of responses (63% and 67%, respectively) neither agreed nor disagreed with either of the survey statements mentioned previously. The data are summarized in Table 13.

Table 13. Perceptions of Functional and Physical Risk

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
New energy efficient tools/technologies will likely work as planned.	8.82%	16.67%	62.75%	9.80%	1.96%
Using new energy efficient tools/technologies will likely pose a risk to others or me.	10.78%	5.88%	66.67%	11.76%	4.90%

The survey included two open-opinion questions in order to expand upon what Marines consider when contemplating functional and physical risk. The first question asked, "What are the likely risks and benefits of using energy-efficient

tools/technologies?" Of the 123 participants, 95 provided an answer. The majority of benefit responses related to cost savings associated with reductions in fossil fuel and battery consumption—similar to previous awareness observations. Surprisingly, the majority of risk answers involved uncertainty with cost associated with functional failure, for example, spending money to implement technologies that then failed or were not effective.

The second question asked, "What causes you to be skeptical or cautious about using energy-efficient tools/technologies?" Ninety-six participants responded. Answers clustered around topics such as a perceived lack of testing prior to fielding, lack of effectiveness, sustainability, and ability to repair. The following quotes are written responses to the two open-opinion functional and physical risk questions discussed previously:

- "Over extending reach. Investing too heavily in a technology that doesn't develop well, or isn't matured to a point of efficiency and dependability. But those pitfalls could easily be avoided, all in all energy efficiency is the only option anyone has long term."
- "lacks efficiency/costly to implement"
- "It breaks too much and in the short term will end up removing a lot of the money that Marines currently are using for tuition assistance and other programs of that nature. Considering that the Marine Corps gets such a small percent of military funding the money could be used elsewhere"
- "Too big of a rush to change to energy-efficient that necessary tests were not completed"
- "new, untried technology" and "it's not proven to be effective"
- "the danger of the tools not being tested"
- "Less power and effectiveness.", "It's weaker.", and "they may not work as well."
- "The amount of experience needed to fix or trouble shoot problems"
- "I believe that the risk of using 'energy-efficient' technologies in a combat zone would be the risk of them breaking. There are only a few people who are trained enough to fix these technologies, and the average grunt is not trained for that. Plus fossil fuels is pretty much grunt proof."

While the largest percentages of survey participants neither agreed nor disagreed that new energy-efficient technologies will likely work as planned or that their use would

likely pose a risk to others or themselves, a surprising number of open-opinion answers revealed that physical risk was not a chief interest. Rather, the functional risk of the technology not working as advertised and the associated cost with the technologies emerged as the primary concern.

4. Perceptions of Advantage, Complexity, and Compatibility

Nearly 67% of survey participants neither agreed nor disagreed that new energy-efficient tools or technologies will likely be more difficult to employ than current tools and technologies. However, exactly the same amount of participants (16%) felt that either new energy-efficient tools or technologies would be or would not be more difficult to use than the tools or technologies currently utilized. Less than 14% felt that new energy-efficient tools or technologies would likely be compatible with current tools or technology (compared to the roughly 17% who believed that new energy-efficient tools or technologies are not compatible with current inventory items). Almost 25% of participants felt that new energy-efficient tools or technologies will require changes in how tasks are performed (versus the 12% who believed that using new energy-efficient tools or technologies will not require altering how their work is accomplished). These data are summarized in Table 14.

Table 14. Perceptions of Advantage, Complexity, and Compatibility

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
New energy efficient tools/technologies will likely be more difficult to use than the tools/technologies I use now.	10.78%	5.88%	66.67%	11.76%	4.90%
New energy efficient tools/technologies will likely be compatible with the other tools/technologies I use now.	8.82%	7.84%	69.61%	10.78%	2.94%
Using new energy efficient tools/technologies will require me to make changes in how I accomplish my work.	7.84%	4.90%	62.75%	18.63%	5.88%

Of note, neither of the battalion commanders who participated in the on-site interviews expressed any apprehension regarding the technologies being harder to use (ease of use perception). Both felt that any increased difficulty encountered with the employment and maintenance of technology would be overcome with training. Training—not the level of difficulty—emerged as the dominant concern. The following are examples of responses that illustrate this viewpoint:

- I think all of that is good, the only piece that comes along with that is the training and the maintenance piece. So when we introduce a new piece of equipment to the battlefield, it is only as good as whether or not we can maintain it or we can train guys to use the item. So we do have a solar powered generator? It is a great thing that could be put out forward as long as we have a Marine that can maintain it and we have somebody who knows how to run the thing. We struggle right now to get Marines into courses—generator, mechanics courses and so forth. So if we get this influx of new technology, if we are already having trouble getting into courses, what is the plan to get the new courses made available to the Marines and to those guys who are going to be expected to run those things forward in a combat zone?

- A constant lack of proper fielding with equipment; I have seen it constantly with systems. More systems get fielded before the proper—I have seen systems get fielded here to the fleet before they are properly fielded to the schoolhouse and integrated into the pipeline. I have seen lack of planning where we eliminate a certain MOS like—what is it—the 2834s, I believe, the satellite maintainers. But we haven't offered the replacement yet, [I believe] we haven't offered the proper training, nor do we plan to. The goal is just they will figure it out and eventually the younger ones will be the ones that grew up having been properly trained. So over the years I have just seen a lot of systems fielded without proper training or proper integration timelines.

Interestingly, among both survey responses and on-site interviews with battalion commanders, complexity was not a concern. Among the survey participants who provided an answer other than "Neither agree nor disagree," the main concern was how the energy-efficient technologies will change the methods used to accomplish Marines' work. The battalion commanders echoed this sentiment with their primary concern of how their Marines will be trained to use and repair the energy-efficient technologies.

5. Perceived Ease of Use and Usefulness and Marine Corps Suitability

Almost 68% of survey participants were unsure whether they would be able to easily understand how to use new energy-efficient tools or technologies. More (18%) rather than fewer (15%) of the Marines surveyed, excluding those who neither disagreed nor agreed (67%), believed that new energy-efficient tools or technologies will likely work as well as the tools or technologies employed now. However, more than 20% of the respondents felt that using new energy-efficient tools or technologies will provide the Marine Corps with greater flexibility in allocating traditional fuels (compared to the less than 11% who do not). These data are summarized in Table 15.

Table 15. Perceived Ease of Use and Usefulness

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
I will be able to easily understand how to use new energy efficient tools/technologies	7.84%	6.86%	67.65%	13.73%	3.92%
New energy efficient tools/technologies will likely work as well as the tools/technologies I use now.	7.84%	9.80%	66.67%	13.73%	1.96%
New energy efficient tools/technologies will provide the Marine Corps greater flexibility in allocating traditional fuels.	5.88%	4.90%	68.63%	16.67%	3.92%

More than 16% of Marines who participated in the survey believed that new energy-efficient tools and technologies will improve the Marine Corps' ability to accomplish its goals, while more than 22% thought that new energy-efficient tools and technologies will make the Marine Corps more combat effective. Both percentages are larger than those who did not feel that use of energy-efficient technology would improve the Marine Corps' ability to accomplish its goals (11%) or provide the Marine Corps more combat effectiveness (15%). The larger respective survey response majorities of 73% and 64% had no opinion. Nearly 65% of survey participants neither agreed nor disagreed that based on what they hear, via word of mouth, they believe that their colleagues think new energy-efficient tools or technologies are valuable to the Marine Corps. However, exactly the same amount of participants (17%) felt that either their colleagues do think or do not think, based on word of mouth, that new energy-efficient tools or technologies are valuable to the Marine Corps. These data are summarized in Table 16.

Table 16. Perception of Marine Corps Suitability

	Strongly disagree	Disagree	Neither agree or disagree	Agree	Strongly agree
New energy efficient tools/technologies will improve the Marine Corps' ability to accomplish its goals.	8.82%	1.96%	72.55%	13.73%	2.94%
New energy efficient tools/technologies will make the Marine Corps more combat effective.	11.76%	2.94%	63.73%	16.67%	4.90%
Based on what I hear (word of mouth), I think that my colleagues believe new energy efficient tools/technologies are valuable to the Marine Corps.	10.78%	6.86%	64.71%	13.73%	3.92%

More rather than fewer of the survey participants who provided an answer other than "Neither agree nor disagree" perceive energy-efficient technologies as useful, usable, and suitable with the Marine Corps.

Overall, the majority of Marines surveyed indicated that they have yet to form either a positive or negative opinion concerning a willingness to adopt, postpone, or resist E2O technologies. Despite several open-opinion responses addressing concerns about the functional risk of energy-efficient technologies, current Marine participant perceptions of the problem, advantage, usefulness, and suitability of these technologies have yet to be determined. However, Marine survey respondents did provide relevant suggestions for increasing enthusiasm concerning energy-efficient technology usage. The key decision-makers who participated in the on-site interviews identified (1) training for the new technologies as a primary driver to resistance, (2) reasons for Marines' not identifying with the commandant's goal, and (3) expressing a conceptual disbelief with the technology.

F. CHARACTERISTICS

The survey included several questions designed to obtain those characteristics of a decision-maker that might affect the knowledge stage along the decision process. These questions requested individual demographic information, including rank (previously reported in the Sample section), age, highest education attained, years of service, number of completed deployments within the previous four years, and military occupational specialty (MOS). The average age of survey participants was 22.2 years, with a standard deviation of 4.9 years. The oldest survey participant was 41 years old, and the youngest survey participant was 17 years old. One hundred percent of survey participants possessed, at a minimum, a high school diploma or equivalent education. Nearly 83% of respondents are currently serving within their first four years of service. These data are summarized in Table 17.

Table 17. Education and Years of Service

Education (please mark highest attained)	Response Percentage	Years of service	Response Percentage
High School Diploma or equivalent	68.63%	less than 2	39.22%
Partial work toward Associates	15.69%	2-4	43.14%
Associates Degree	0.98%	4-6	7.84%
Partial work toward Bachelors	4.90%	7-10	2.94%
BS/BA	5.88%	11-15	2.94%
Partial work toward Masters	0.98%	16-20	2.94%
Master's Degree	0.00%	21-26	0.00%
Partial work toward Doctorate	0.98%	more than 26	0.98%
PhD	0.98%		
Other	0.98%		

More than half (53%) of the respondents reported having conducted at least one deployment in the previous four years. More than 97% of survey participants hold an infantry MOS. The data are summarized in Table 18.

Table 18. Previous Deployments and Military Occupational Specialty

How many deployments have you completed within the past four years?	Response Percentage	MOS/Specialty	Response Percentage
0	47.06%	Infantry	97.06%
1	32.35%	Artillery	0.00%
2	14.71%	Communication	0.00%
3 or more	5.88%	Other	2.94%

G. IMPLEMENTATION

The on-site interviews were designed to collect additional thoughts and further details from key decision-makers. The topic of technology implementation permeated almost every on-site interview. Additional comments on technology implementation, not mentioned in previous sections of this chapter, indicated concern that a lack of current energy-efficient technology systems availability is preventing solicitation to decision-makers for implementation consideration and described implementation prejudices caused by previous wayward system implementations. The following examples illustrate these concerns:

- I think it is easy to convince a lance corporal that this is more efficient for you. They will do what they are told in that regard and he will understand the benefits of it when he is reaping the reward. He doesn't have to leave and go on a patrol to go get more batteries. He is able to just put a charger out. To me, that is an easy sell but you are going to need to convince people that it is probably going to be at a higher level I would say.
- So when the MRAP first came out, it was immediately fielded and we did not have the mechanics in our units that could work on the vehicle. So we would have to deploy with civilian contractors as the only ones that could do the work. That slowed down the log train so anytime a vehicle would go to third level echelon, it would have to go to third level echelon for the simple reason that none of our Marines could work on it. We just now caught up with that technology. So again, what we were just talking about, that was one that was a demand that was needed to fight IEDs, provide a better vehicle, it was provided to us, but the catch up process to get it going has caused some significant issues.
- Same thing with the [aero scout] today; so the [aero scout] is generated and worked by civilian contractors. So the issues that we run into is if we want to put a PB out in a certain area, it is no longer just a tactical scenario, if it drives, whether or not we can put the PB there, but it is also

whether or not it can support the civilian requirements that go along with that [aero scout] and those requirements aren't so much capability or use it is security and safety for the civilians who do not have the same concerns that we do. So those are some of the things that drive those [uses]. So great technologies that provided a lot for the Marine Corps, but a lot of constraints up front with the [aero scouts] continuing today in their uses.

- Well I look at it the same way the SKL got fielded. You know, we have got a system that we know how to use with the CYZ-10 and we got operators and a maintenance chain as well as people who know how to use it, program it and so forth. Then you give us a new piece of gear, and what I saw with the implementation of the SKL was here is the one for one swap, but oh by the way, we haven't trained any of the users on it, your higher doesn't know how to use it, they don't know how to program it and there is no training at any tiered level for how to actually implement it to its full capacity. So that portion doesn't catch up to the field until now you are stuck, you don't even have the previous system anymore, but you don't have anybody who knows how to use it and the expectation is that oh no, it works on paper.
- So over the years I have just seen a lot of systems fielded without proper training or proper integration timelines. Usually Marines figure it out, but it is not without a lot of pain and the systems usually get a bad name. I mean most places you go, GCSS Marine Corps nobody wants anything to do with it, but it is—we are seeing the value of the system, but it really has a bad name and it is not because it is not a capable system, it is because the strategic communication side of it was done very poorly.

The preceding examples concern negligent technology implementation and reveal the discussed associated apprehensions. Although none of these example relate specifically to energy-efficient technologies, the implementation concerns that they highlight will likely have to be addressed in order to increase the acceptance of energy-efficient tools and technologies within the Marine Corps.

H. CONCLUSION

This chapter reported results of analysis of data collected from both an anonymous online survey instrument and on-site interviews with FMF units. Among the variety of responses, the data and analysis highlighted several areas to address in order to facilitate further acceptance and mitigate resistance to the adoption of energy-efficient technologies across the Marine Corps. The overall study findings are presented in the

next chapter. The author annotated key issues and discussed possible recommendations to better improve Marine Corps energy-efficient technology acceptance.

V. FINDINGS, DISCUSSION, AND RECOMMENDATIONS

A. INTRODUCTION

This research was designed to support the acceptance and adoption of energy-efficient technologies by the United States Marine Corps through an exploration of Marines' attitudes and willingness to adopt energy-efficient technologies. I examined how particular individual attributes may affect Marines' assessments of energy-efficient technologies. Drawing on a framework developed from the academic literature, I focused on the impact of a person's prior conditions, knowledge, and perception of technologies on the decision to adopt, postpone, or resist new technologies. Chapter V summarizes the findings as well as the implications drawn from them. The chapter concludes with recommendations for improving Marines' acceptance of energy-efficient technologies.

B. ACCEPTANCE AND RESISTANCE DRIVERS

1. Awareness

The literature review suggested that awareness is a contributing factor to the knowledge stage within the decision-making process. In terms of this research, awareness assessed Marine's familiarity and understanding of the commandant's goal, E2O initiatives, sources from where information was received, and satisfaction based upon experience. The knowledge stage within the research framework may be influenced by the prior conditions stage and could impact the perception stage, possibly impacting the decision to adopt, postpone, or resist energy-efficient technologies.

The adoption of energy-efficient technologies is outlined within the United States Marine Corps Expeditionary Energy Strategy and Implementation Plan: "Bases-to-Battlefields" (Conway, 2010) and the All Marine Corps Activities (ALMAR) message 011/11. However, the research data indicated that there appears to be a large lack of awareness within the battalion level concerning actual technologies and methods for the way ahead in achieving the CMC's goal to reduce dependence on traditional fuel and increase capability for deployed Marine forces through new technologies and procedures.

The data analysis suggested that while Marines do understand the concept of how energy-efficient technologies could provide benefits to the Marine Corps, they do not commonly understand the CMC's goal and E2O's roles in achieving that goal.

The literature review proposed that the identified lack of awareness may limit knowledge used within the decision-making process when determining to accept or reject any energy-efficient technology. However, the data collected in this research inferred that the identified lack of awareness has not yet negatively impacted future decisions of Marines to adapt or reject energy-efficient technologies. The link between the literature review's proposal of a lack of knowledge affecting a decision and the collected data makes sense; it is hard to resist, postpone, or accept something that you know nothing about.

2. Functional Risk

The literature review suggested that functional risk is an important factor that may affect both the prior conditions and perception stages along the decision-making process. For purposes of this research, functional risk assessed Marines' doubts concerning the performance of energy-efficient technologies. Will the technology work, and what will be the repercussions if it does not? Functional risk may affect usage patterns, which are a contributing factor to the prior condition stage of the decision-making process. Within the developed research framework, functional risk may also be a contributing factor to the perception stage. Both the prior condition and perception stages may influence the decision to adopt, postpone, or resist technologies.

The data implied that Marines would be hesitant and unenthusiastic to employ any energy-efficient technologies within an evaluated training environment or combat environment due to functional-risk concerns and the subsequent accountability actions sought; being held responsible or associated with mission failure due to the technology failing. The data implied that functional risk may lead to Marines' choosing not to use the technology if given an option or perceiving the technology as not offering any useful advantage over current systems.

Unsubstantiated functional-risk concerns may negatively affect both prior conditions (usage patterns) and perception (usefulness or advantage) decision-making stages when deciding to accept a new energy-efficient technology. Conversely, alleviated functional-risk concerns could positively impact the same stages in the decision process. The data suggested that Marines feel that opportunities to experiment with the equipment in unevaluated training environments would alleviate some functional-risk concerns and may create more enthusiasm toward employment in other environments. Overall, the data collected supported the research framework in that a lack of functional risk is a driver of acceptance while a presence of functional risk is a driver to resistance.

3. Image and Relative Advantage or Disadvantage

The literature review suggested that image and relative advantage or disadvantage are contributing factors to the perception stage of the decision-making process and could also affect the prior conditions stage. In this research, assessing Marines' image of energy-efficient technologies involved ascertaining opinions on energy-efficient technology complexity, compatibility with current tasks, and suitability with the mission of the Marine Corps. Within the context of this research, relative advantage and disadvantage described perceived technology attributes concerning the technology's usefulness and ease of use. Both the prior condition and perception stages may be affected by image and the relative advantage or disadvantage of energy-efficient technologies, which could influence the decision to adopt, postpone, or resist the technologies.

The collected data indicated that a general lack of conceptual belief in the technology exists (e.g., the technology will not work as advertised); cost and any advantage offered by using new energy-efficient technologies would be truncated by a wayward implementation plan primarily involving a lack of training associated with maintenance and repair.

The disbelief in the technology's ability centered on the lack of civilian implementation, which makes sense. If energy-efficient technologies are more cost-effective and truly energy-efficient, why are they not more popular and in higher

demand? However, the data also revealed publishing a report indicating the level of cost effectiveness and efficiency achieved in using the energy-efficient technologies would improve the technology's image.

The data showed that a dysfunctional implementation plan would likely create a negative prejudice associated with any energy-efficient technology, regardless of any actual tangible advantages that the technology may provide. A lack of repair and a lack of maintenance training concerning any fielded equipment were the focus points concerning perceptions of advantage and disadvantage, which makes sense. Whatever advantage any energy-efficient technology offered would be obsolete if the accompanying skill sets to repair and maintain the technologies were not provided. A technology is no good to any Marine if his unit cannot run it or fix it.

However, the data also indicated that providing ample maintenance and repair training could increase perceptions of advantage, even if the technologies were harder to operate. The data collected indicated that receiving the desired training would alleviate any associated disadvantages stemming from complexity. Overall, the data collected supported the literature review in that image and perceptions of relative advantage and disadvantage can be drivers to both resistance and acceptance of energy-efficient technologies.

C. RECOMMENDATIONS

Several ideas emerged during the conduct and analysis of this research that should minimize the identified resistance drivers to adapting energy-efficient technologies. The following section will offer three suggestions derived from academic literature, data analysis, and specific recommendations from research participants. None of the following recommendations are mutually exclusive, but applying them independently, in totality, or in some combination may lead to further acceptance of energy-efficient technologies. The following recommendations are categorized under increasing awareness, improving image, and effective implementation.

1. Increasing Awareness

The Marines who participated in this study were largely unaware of new E2O-sponsored energy-efficient technologies. Previous research suggested that awareness is a key driver of technology acceptance. Intuitively, most understand it will be difficult for Marines to make informed decisions on something that they know nothing or little about. The lack of awareness can be viewed as an opportunity. The data showed that many Marines have yet to form an opinion about energy-efficient technologies. This lack of current opinion provides a window of opportunity to influence Marines' future opinions as they are developing. Increasing awareness should be a key focus of E2O efforts. This study suggests some specific avenues through which to increase awareness. The E2O should increase awareness of "*Bases-to-Battlefields,*" the E2O's role in achieving the commandant's goal, and E2O technologies through a simultaneous multi-tiered approach instituted through not only Headquarters Marine Corps messaging but also FMF unit and training institution participation, to include engaging officers in guided discussions and providing demonstrations and hands-on experience.

Engage officers in guided discussions. Through Headquarters Marine Corps, the E2O should create discussions at the officer level and increase CMC messaging concerning the *United States Marine Corps Expeditionary Energy Strategy and Implementation Plan*. To accomplish both of these tasks, I recommend that E2O involve commanders at the regimental level in conducting guided discussions and hold them accountable for ensuring the dissemination of distributed messaging (perhaps part of an annual training video block). Guided discussions concerning commander expectations with regard to the *Expeditionary Energy Strategy* should be incorporated into sessions held at the Commander's Course, Marine Corps Command and Staff War College, and the Expeditionary Warfare School. These incorporated guided discussions could focus the leaders at all levels of the Marine Corps simultaneously. Additionally, E2O should direct company commander-and officer-guided discussion engagements with subordinate Marines. This recommendation is congruent with specific suggestions made by Marines participating in the survey. The following is a sample of those suggestions:

- Yes, and it certainly necessitates a shift in the mindset from the leadership level before you are going to be able to effect much in terms of your Marines just at the company level. We are talking about proving to the Marines that this is a good way to do business, be it discussing it as a company commander at the company level and making sure that they understand. Maybe how tied it is to the strategic level, like to bring that into it, but I think that you need to prove to them that it is effective as well before you are going to get a lot of buy in.
- I think at the company level it has to be addressed from the CO at a company level, battalion. The Marines need to hear it multiple times. Articles need to be—I mean Marines need to see it visually and then they will start, "Oh, I have heard the CO talk about this and now I am reading about it. The commandant just gave a speech just last week.
- I think it is easy to convince a lance corporal that this is more efficient for you. They will do what they are told in that regard and he will understand the benefits of it when he is reaping the reward. He doesn't have to leave and go on a patrol to go get more batteries. He is able to just put a charger out. To me, that is an easy sell but you are going to need to convince people that it is probably going to be at a higher level I would say.

Provide demonstrations and hands-on experience. I recommend that the E2O offer FMF units access to exhibition demonstrations (perhaps a temporary experimental forward operating base at a camp field house). This could provide many Fleet Marines with an opportunity to see the technologies for the first time. The E2O should introduce the technologies at all entry-level training in some capacity. Although fielding a whole company of candidates at Recruit Training or Marine Combat Training or an entire Basic School company of lieutenants is probably not feasible, outfitting even a single squad would create the opportunity for observation and discussion, possibly leading to increased awareness. This recommendation is supported by specific suggestions made by Marines participating in the survey. The Following is a sample of those suggestions:

- "I would start at the schoolhouse, like from there."
- They bring all the systems down and they kind of do like a convention. They set up over here at the field house and have all of your systems out and available and the Marines can see what they are, leadership can see what they are and what capability they bring. They can actually see it operating and how it works.
- By having the Marines use it. By having them buy into it like this (expletive deleted) works. Like this—you know—this stuff we can do like sustainment, sitting on a FOB, like we don't have to worry about air

> dropping anything or logistics coming through and getting blown up by an IED. Like hey, we can do this ourselves, we don't have to rely on anybody else really.

Messaging, discussion, and demonstration would reinforce each other: The Marines will witness the commandant's messaging, see the technologies, and have discussions with their immediate superiors about them. The opportunities to hear, see, and discuss could exponentially increase awareness.

As discussed previously, the academic literature showed that awareness or an understanding of the technology is an individual characteristic that may influence individuals' decisions to adopt the technology. Individual characteristics, including awareness, have been shown to affect the decisions to adopt, postpone, or resist technologies. The data analysis showed a lack of awareness among the Marines who participated in this study. However, at the time of this research, a lack of awareness did not seem to have negatively impacted Marines' decisions to adopt or reject energy-efficient technologies. Specific recommendations from research participants prescribed CMC messaging, commanding officer engagement, personal mentorship, and introducing the technologies within entry-level training environments.

2. Improving Image

Most Marines who participated in this study reported the belief that the Marine Corps is incorporating energy-efficient technologies for financial reasons or because of temporary social expectations that align with the current social fad to support energy efficiency. These misconceptions, in combination with the current lack of awareness, can be viewed as an opportunity to provide alternative justifications for the Marine Corps' adoption of energy-efficient technologies. The data showed that improving the image of energy-efficient technologies requires addressing several separate but interwoven factors. These factors include focusing the effort on tying energy-efficient technologies to the Marine ethos, reducing functional-risk concerns, and addressing compatibility, capability, and combat-effectiveness considerations.

Nest energy-efficient technologies' use with force protection and sustainability. The data collected implied that most Marines who have no experience

with energy-efficient technologies feel that the Marine Corps' push for the adoption of these technologies is driven by economic versus expeditionary concerns. I recommend that when the E2O provides messaging about energy-efficient technologies, it nests the technologies' use strongly within increasing capability to force protection and increasing sustainability—rather than emphasizing gallons per Marine per day or monetary considerations. Marines understand expeditionary concepts and the dangers of going on patrol for consumables. Emphasizing more of the expeditionary links may facilitate quicker adoption of energy-efficient technologies within our ethos. This recommendation is consistent with the following specific suggestion made by one Marine participating in the survey:

- • Tie it to our ethos. Marines understand the inherent danger of going down an IED ridden road for constant resupply of something that is a consumable. If they can reduce that, they reduce the amount of patrols and it is tied directly to force protection. That message is—we are very receptive to that I think inside of our community, the ability to be self-reliant I think is always going to be prime in our mindset. So continuing to push that message or that theme of this reduces outside requirements, makes us more survivable, and makes us more expeditionary. It continues to be a good selling point.

Advertise success to diminish risk. The data collected suggested that functional risk may be one of the primary concerns when deciding to adopt, postpone, or resist technologies. I recommend that the E2O disseminate publications citing gained advantages through the employment of energy-efficient technologies. This may reduce functional-risk concerns. This approach could increase Marine confidence that the technologies will actually work and also offer assurances that the technologies are compatible with current missions, which could increase the capability and effectiveness of Marines. Reports could include both tactical and base examples. This recommendation is supported with specific suggestions made by Marines participating in the survey. Following is a sample of those suggestions:

- • So when I look at the solar farms I ask myself how much did that cost to do that solar farm. I see these new barracks that are being built with the overhang garages with solar power and I see these old barracks and I am like how much of that money could have been taken to pump into these barrack spaces? I don't know. The other question I have is if we are

putting solar power to use, let's see how effective it is. Produce a report that states of these so many solar panels that we have installed at Camp Lejeune, they have produced this amount of electrical power, which has therefore decreased the need for the coal plant on base to produce power, which has saved us this amount of money. You never see that. So my initial question is, are we really saving any money?

- • I mean everybody is on the Internet, websites would probably be the best place to go and just have a website dedicated to information and putting that information out there. Maybe different types of equipment that the Marine Corps is fielding, concepts, getting a lot of feedback on that. I think if you educate the Marines, put that information out there, the upcoming technology, I think they would get excited.

As mentioned earlier, the academic literature suggested that image and functional risk may affect perceptions and adoption of technologies. The data analysis highlighted several concerns throughout the chain of command regarding functional risk, implementation, how the technologies will change the methods used to accomplish individual tasks, and the effects on the capability and combat effectiveness of Marines. Specific recommendations from research participants included embedding the adoption of energy efficiency within current ethos, reducing functional-risk concerns, and addressing compatibility, capability, and combat-effectiveness considerations.

3. Effective Implementation

Many Marines who participated in the research expressed preconceptions about any new system that is implemented within the Marine Corps. Although not specifically part of the research framework, it is feasible to infer from the literature review how the benefits of effective system implementation—and the repercussions of ineffective system implementation—could affect all decisions to adopt, postpone, or resist technologies. The data analysis suggested that system implementation could be a primary concern based upon prejudices developed during personal experiences with ineffective system implementations. However, the data analysis also inferred that marginalizing these prejudices through proper fielding and training may lead to effective implementation of energy-efficient technologies by United States Marines.

Simultaneous fielding. I recommend that E2O incorporate new energy-efficient technologies within curriculums of the schoolhouses and plan for the dual fielding of the technologies in conjunction with Marines who can maintain and repair the technologies at the FMF unit level. This recommendation stems from statements made by Marines participating in the survey. The following is a sample of these statements:

- A constant lack of proper fielding with equipment; I have seen it constantly with systems. More systems get fielded before the proper—I have seen systems get fielded here to the Fleet before they are properly fielded to the schoolhouse and integrated into the pipeline. I have seen lack of planning where we eliminate a certain MOS like—what is it—the 2834s, I believe, the satellite maintainers. But we haven't offered the replacement yet, [I believe] we haven't offered the proper training, nor do we plan to. The goal is just they will figure it out and eventually the younger ones will be the ones that grew up having been properly trained. So over the years I have just seen a lot of systems fielded without proper training or proper integration timelines.
- I think all of that is good. The only piece that comes along with that is the training and the maintenance piece. So when we introduce a new piece of equipment to the battlefield, it is only as good as whether or not we can maintain it or we can train guys to use the item. So we do have a solar powered generator? It is a great thing that could be put out forward as long as we have a Marine that can maintain it and we have somebody who knows how to run the thing.

Train the Marines. Promoting effective implementation involves training. Marines must be trained in the skills and knowledge required for maintenance and repairs. Units should also be mandated to train with the energy-efficient technologies once they are available. This mandated training with available energy-efficient technologies should occur through a one-for-one inventory swap or decrease in allotted consumables. This approach would force the Marines to learn how to employ the equipment and reduce the requirement for excessive maintenance and accountability caused by multiple system redundancy. Additionally, ensure that the ability to maintain and repair the technologies exists at the FMF unit level in conjunction with the fielding of the technologies. This recommendation is supported by specific suggestions made by Marines participating in the survey. The following is a sample of those suggestions:

- Force us to use it. I mean if you do a one for one swap it forces us to use it and as long as it has that guarantee back in it saying yes the MARFORSYSCOM says yes this is going to work just like a regular generator when it comes to liability and type of power it produces, I mean that is enough for me to take confidence in it and let it prove otherwise. But, force it to us. Force us to use it because if it comes down to them saying, 'Hey we are going to give you these systems. Use it when you go out to the field.' But, the Marine Corps ultimately says, 'Oh, you have generators to maintain and take out to the field as backup.' I am just going to take the generators because to a point it is overkill. It is too much work.
- We struggle right now to get Marines into courses—generator, mechanics courses and so forth. So if we get this influx of new technology, if we are already having trouble getting into courses, what is the plan to get the new courses made available to the Marines and to those guys who are going to be expected to run those things forward in a combat zone?

Properly fielding energy-efficient technologies by ensuring that they are incorporated within the "pipeline" may alleviate many functional-risk, compatibility, suitability, and effectiveness concerns among commanders. Both academic research and analysis of the data, collected during this study, indicated that alleviating some of these concerns may contribute toward effective implementation of energy-efficient technologies within the Marine Corps.

D. CONCLUSION

I found through the analysis of data collected for this study that awareness, functional risk, and perceptions of both image and relative advantage or disadvantage could be key drivers of resistance or acceptance of energy-efficient technologies by United States Marines. Addressing any lack of awareness, functional-risk concerns, or prejudicial image and implementation perceptions may help to minimize resistance and encourage a decision to adopt rather than postpone or resist energy-efficient technologies. These findings suggest areas of concern and opportunity as well as general and specific recommendations going forward, based on academic research, data analysis, and specific recommendations from research participants.

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VI. CONCLUSION

A. FINAL THOUGHTS

This research was designed to support the acceptance and adoption of energy-efficient technologies by the United States Marine Corps through exploring what influences Marines' attitudes and willingness to adopt such technologies. The research consisted of developing a research framework from the academic literature to guide data collection and analysis. I then used the data analysis to identify acceptance and resistance drivers, which facilitated making recommendations to mitigate resistance and improve acceptance decisions. This chapter briefly describes the initial goal of the research, the framework developed to achieve the research goal, the analysis methodology, observations, and recommendations. The chapter then provides limitations of the research and recommendations for further research and concludes with overall benefits of the study.

1. Research Goal

The United States Marine Corps Expeditionary Energy Office called for research to better understand how messaging and behavioral factors will influence the shaping of a combat effective-energy posture within the Marine Corps. Addressing this call, the objective of this study was to determine what drives United States Marines' acceptance of and resistance to energy-efficient technologies. This research

a. identified the degree to which Marines are supportive of or resistant to efficient energy technologies,

b. examined the roles played by cognitive factors (awareness and understanding) and affective factors (attitude and perception) on stated willingness to adopt or resist efficient energy technologies, and

c. assessed the most likely levers for influencing cognitive and affective factors to support Marines' adoption of efficient energy technologies.

2. Research Framework

This study identified, described, and utilized three technology adoption and diffusion models to guide exploration of Marines' predispositions toward and triggers likely to influence energy-efficient technology adoption, postponement, and resistance decisions. This study is based on a framework developed from an adaptation of the DoI model (Rogers, 2003; Wilson & Dowlatabadi, 2007) elaborated with the TAM (Davis, 1989) and the resistance hierarchy (Kleijnen, Lee, & Wetzels, 2009).

The DoI model identified factors that influence the adoption or rejection decision process within a social context considering influences, ideas, behaviors, and communication. The TAM identified the individual factors, perceived usefulness, and ease of use that influence information technology acceptance. The resistance hierarchy identified antecedents to resistance. Together, the theories provided the research framework that guided this study.

The research framework then drove the construction of an anonymous survey and interview protocol in order to collect data to:

1. assess Marines' awareness of the CMC's energy objective, the E2O's initiatives, and energy-efficient technologies; sources of information on energy-efficient technologies; and satisfaction based upon experience with energy-efficient technologies;
2. identify Marines' perceptions regarding energy-efficient technologies, including perceptions of the problem, fit with Marine traditions and mission, functional and physical risk, relative advantage, complexity and compatibility, and ease of use and usefulness;
3. assess Marines' judgment of the value of energy-efficient technologies;
4. contrast Marines' acceptance of energy-efficient technologies in different environments; and
5. assess Marines' willingness to adopt, postpone, or resist energy-efficient technologies.

3. Analysis Methodology

The purpose of the data analysis was to examine the degree to which United States Marines are supportive of or resistant to efficient energy technologies. Data were

collected through an online survey and face-to-face on-site interviews. A solicitation e-mail containing an anonymous survey link was sent to several FMF units consisting of more than 300 total Marines. 123 usable surveys were returned, for a response rate of approximately 41%, and 11 on-site interviews were conducted with key decision-makers. Research participants consisted of officers in the ranks from chief warrant officer 2 (CWO2) through lieutenant colonel (O-5) and enlisted ranks between private (E-1) and sergeant major/master gunnery sergeant (E-9).

Analysis of the survey and on-site interview transcriptions was driven by a hermeneutic process using an inductive theory-building approach involving a series of meaning condensation and categorizing. An initial reading of the responses provided an understanding of the data. Subsequently, responses were categorized, coded, and compared to one another, which afforded the basis for identifying acceptance and resistance drivers— the basis for the recommendations provided in the previous chapter.

4. Observations and Recommendations

The research framework developed from the academic literature guided the analysis of the collected data. The analysis showed that Marines mention awareness, perception of functional risk, image, and relative advantage or disadvantage more often than other factors identified in the academic literature as influencers of decisions to adopt technologies. These identified factors suggest that the factors that Marines mention may be more important to them than the other factors identified within the literature review.

This study resulted in recommendations that could minimize the aforementioned resistance drivers to adopting energy-efficient technologies. The specific recommendations derived from this research include methods for increasing awareness, improving image, and facilitating effective implementation.

B. RESEARCH LIMITATIONS

This research surveyed and interviewed Marines from two separate FMF units located within the same geographical location where the responses may have been influenced by the similar geographical setting in which the survey was conducted. Also,

a significantly larger percentage of survey responses and a majority of the on-site interviews originated from the same unit. Responses might vary if collected from different functional and geographically located units. More than 76% of the survey respondents consisted of the ranks from private (E-1) to lance corporal (E-3). More responses from senior personnel may have provided further insight. The study participants only included active duty personnel, and the results may be different for reserve Marines.

C. RECOMMENDATIONS FOR FURTHER RESEARCH

Additional studies exploring what influences Marines' attitudes and willingness to adopt energy-efficient technologies could arrange the participation of a greater variety of functional units encompassing air, ground, and support elements from a variety of geographical locations. Future research could increase participation of more senior personnel, possibly providing greater understanding. Further studies could also incorporate the participation of reserve personnel, who may possess different opinions than active duty personnel.

D. BENEFITS OF THIS STUDY

This study examined how particular factors may affect individual Marines' decisions to adopt, postpone, or resist energy-efficient technologies and makes recommendations for minimizing resistance drivers to improve Marines' acceptance of energy-efficient technologies. The research findings may offer the Marine Corps a clearer understanding of acceptance and resistance drivers and the means to facilitate greater acceptance of energy-efficient technologies.

APPENDIX. E2O RESEARCH SURVEY

Thank you for participating in this short and completely anonymous survey. The survey encompasses determining what drives Marines acceptance of and resistance to efficient energy technologies. The end state is to facilitate the reduction of Marine casualties sustained while delivering fossil fuel. Currently one Marine is killed or wounded in action every 50 convoys.

Section A: Consent

A1. **Introduction. You are invited to participate in a research study entitled Key drivers of Marines' willingness to adapt energy efficient technologies. The purpose of the research is to explore adaptation drivers and assess the willingness of Marines' to accept energy efficient technologies, reducing fossil fuel dependencies down range and thus decreasing the number of Marines WIA/KIA associated with supply convoys. Procedures Participants will complete an on-line survey lasting about 20 minutes 250 subjects will be participating in the research, Location. The survey will take place aboard Camp Lejeune, NC. Cost. There is no cost to participate in this research study. Voluntary Nature of the Study. Your participation in this study is strictly voluntary. If you choose to participate you can change your mind at any time and withdraw from the study. You will not be penalized in any way or lose any benefits to which you would otherwise be entitled if you choose not to participate in this study or to withdraw. The alternative to participating in the research is to not participate in the research. Potential Risks and Discomforts. The potential risks of participating in this study are minimal. Risk of breach of confidentiality. Subject email addresses not linked to data. Anticipated Benefits. Anticipated DoD/DoN benefits from this study include identifying drivers of willingness to accept energy efficient technologies. The adaptation of energy efficient technologies will significantly reduce fossil fuel dependency for forward deployed and home stationed personnel. You will not directly benefit from your participation in this research. Compensation for Participation. No tangible compensation will be given. Confidentiality**

Yes ☐

No ☐

Section B: Awareness

B1. **Are you aware of the Commandant's goal of reducing dependence on traditional fuel and increasing capability for deployed Marine forces through new technologies and procedures?**

- ☐ Yes
- ☐ No

B2. **How did you become aware of the goal? (please check all that apply)**

- ☐ Informal word of mouth from another Marine (another Marine told me about it)
- ☐ Informal electronic communication from another Marine (another Marine sent me an email)
- ☐ Offcial communication from Marines
- ☐ DoD website
- ☐ DoD printed newsletter
- ☐ Prior to this survey I was not aware of the goal
- ☐ I don't know
- ☐ Other

Other

B3. **Have you heard of the Marine Corps Expeditionary Energy Office, also called E2O?**

- ☐ Yes
- ☐ No

B4. How did you become aware of the Marine Corps Expeditionary Energy Office (E2O)?

- ☐ Informal word of mouth from another Marine (another Marine told me about it)
- ☐ Informal electronic communication from another Marine (another Marine sent me an email)
- ☐ Official communication from Marines
- ☐ DoD website
- ☐ DoD printed newsletter
- ☐ Prior to this survey, I was not aware of the E2O office
- ☐ I don't know
- ☐ Other

Other

B5. The Marine Corps Expeditionary Office (E2O) has developed new energy effcient technologies. Which Marine Corps E2O tools/technologies do you know about?

- ☐ SPACES
- ☐ GREENS
- ☐ LED Lighting
- ☐ Solar Light Poles
- ☐ Zero Base
- ☐ Radiant Tent Liners
- ☐ None
- ☐ Other

Other

B8. In what circumstances have you used Marine Corps E2O tools/technologies?

- [ ] Never
- [ ] Humanitarian mission
- [ ] CONUS training
- [ ] OCONUS training
- [ ] Combat operations
- [ ] Other

Other

B9. Please rate your satisfacton with Marine Corps E2O tools/technologies that you have used or tried.

- [ ] 1 Not at all satisfied
- [ ] 2 Somewhat not satisfied
- [ ] 3 Neither satisified or not satisfied
- [ ] 4 Somewhat satisfied
- [ ] 5 Satisfied
- [ ] 6 Extremely satisfied
- [ ] I have no experience with E2O technologies

B10. With whom have you informally discussed the Marine Corps and energy efficiency?

- [ ] Marine peers
- [ ] Marine superiors
- [ ] Marine subordinates
- [ ] Family
- [ ] Civilian friends
- [ ] I have not discussed the Marine Corps and energy efficiency with others
- [ ] Other

Other

Section C: Open Opinion

Please answer the following open ended questions with as much detail as possible. Your written responses to these questions will help me understand your individual opinions.

C1. Some tools and technologies are "energy effcient." Please list one or several technologies or products that you consider to be examples of "energy efficient technologies."

C2. What tools or technologies do the examples you listed above replace?

C3. **In your opinion, what Marine Corps problems or needs can energy efficient tools/technologies address now or in the immediate future (if none please explain)?**

C4. **In your opinion, what additional Marine Corps problems or needs could energy efficient tools/technologies address in the longer term (if none please explain)?**

C5. **What are the likely risks and benefits of using energy efficient tools/technologies?**

C6. **What causes you to be skeptical or cautious about using energy efficient tools/technologies?**

C7. **What would make you more enthusiastic about using energy efficient tools/technologies?**

Section D: Environment

D1. **If given the choice, how likely are you to employ new energy efficient tools/technologies in an un-evaluated training environment?**

- 1 Not at all likely ☐
- 2 ☐
- 3 ☐
- 4 ☐
- 5 ☐
- 6 Extremely likely ☐
- 7 I don't know ☐

D2. **How enthusiastic are you about using new energy efficient tools/technologies in an evaluated training environment?**

- 1 Not at all enthusiastic ☐
- 2 ☐
- 3 ☐
- 4 ☐
- 5 ☐
- 6 Extremely enthusiastic ☐
- 7 I don't know ☐

D3. **If given a choice, how likely are you to use energy efficient tools/technologies in a combat environment?**

- 1 Not at all likely ☐
- 2 ☐
- 3 ☐
- 4 ☐
- 5 ☐
- 6 Extremely likely ☐
- 7 I don't know ☐

D4. **How valuable are energy efficient tools/technologies likely to be to Marines?**

- 1 Not at all valuable ☐
- 2 ☐
- 3 ☐
- 4 ☐
- 5 ☐
- 6Extremely valuable ☐
- 7 I don't know ☐

Section E: Perception

Please indicate the extent to which you AGREE or DISAGREE with the following statements.

1=Strongly Disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly Agree

E1. **Dependence on traditional energy could put Marines at risk.**

- 1 Strongly Disagree ☐
- 2 Disagree ☐
- 3 Neither agree nor disagree ☐
- 4 Agree ☐
- 5 Strongly Agree ☐

E2. **I am interested in trying new energy efficient tools/technologies now or as soon as possibile.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E3. **I would only be interested in trying new energy efficient tools/technologies after others I know have tried them.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E4. **Increasing energy efficiency and reducing the use of traditional fuels are consistent with the Mission of the Marine Corps.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E5. **I have or I am likely to criticize new energy efficient tools/technologies or to discourage others from using them.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E6. **New energy efficient tools/technologies will likely work as planned.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E7. **Using new energy efficient tools/technologies will likely pose a risk to others or me.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E8. **New energy efficient tools/technologies will likely be more difficult to use than the tools/technologies I use now.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E9. **New energy effcient tools/technologies will likely be compatible with the other tools/technologies I use now.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E10. **Using new energy efficient tools/technologies will require me to make changes in how I accomplish my work.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E11. **I will be able to easily understand how to use new energy efficient tools/technologies**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E12. **New energy efficient tools/technologies will likely work as well as the tools/technologies I use now.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E13. **New energy efficient tools/technologies will provide the Marine Corps greater flexibility in allocating traditonal fuels.**

1 Strongly Disagree ☐
2 Disagree ☐
3 Neither agree nor disagree ☐
4 Agree ☐
5 Strongly Agree ☐

E14. **New energy efficient tools/technologies will improve the Marine Corps' ability to accomplish its goals.**

- 1 Strongly Disagree ☐
- 2 Disagree ☐
- 3 Neither agree nor disagree ☐
- 4 Agree ☐
- 5 Strongly Agree ☐

E15. **New energy efficent tools/technologies will make the Marine Corps more combat effective.**

- 1 Strongly Disagree ☐
- 2 Disagree ☐
- 3 Neither agree nor disagree ☐
- 4 Agree ☐
- 5 Strongly Agree ☐

E16. **Based on what I hear (word of mouth), I think that my colleagues believe new energy efficient tools/technologies are valuable to the Marine Corps.**

- 1 Strongly Disagree ☐
- 2 Disagree ☐
- 3 Neither agree nor disagree ☐
- 4 Agree ☐
- 5 Strongly Agree ☐

Section F: Characteristics

F1. **Please fill in your age** ☐☐☐☐☐☐☐☐☐☐

F2. Please select your rank

- E1-E3 ☐
- E4-E6 ☐
- E7-E9 ☐
- WO1-CWO3 ☐
- CWO4-CWO5 ☐
- O1-O3 ☐
- O1E-O3E ☐
- O4-O6 ☐
- O7-O10 ☐
- Other ☐

Other

F3. Education (please mark highest attained)

- High School Diploma or equivalent ☐
- Partial work towards Associates ☐
- Associates Degree ☐
- Partial work towards Bachelors ☐
- BS / BA ☐
- Partial work towards Masters ☐
- Masters Degree ☐
- Partial work towards Doctorate ☐
- PhD ☐
- Other ☐

Other

F4. How many deployments have you completed within the past four years.

- 0 ☐
- 1 ☐
- 2 ☐
- 3 or more ☐

F5. Years of service

- less than 2 ☐
- 2-4 ☐
- 4-6 ☐
- 7-10 ☐
- 11-15 ☐
- 16-20 ☐
- 21-26 ☐
- more than 26 ☐

F6. MOS/Specialty

- Infantry (please list MOS) ☐
- Artillery (please list MOS) ☐
- Communication (please list MOS) ☐
- Other (please list MOS) ☐

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